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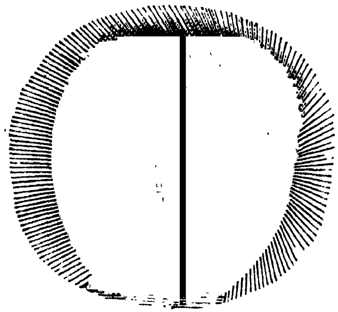

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The science of Geology is an eminently popular one; but only the present generation can be said to possess its advantages as a branch of education. Three-quarters of a century ago, Geology was not unfrequently turned into open ridicule. Now, it has become a branch of Public Education; and there is not a more attractive subject for the lecture-room of our various institutions—from the stately Athenæum to the parochial school-room—than the illustration of the theory of the origin, structure, and successive changes of the globe, which is the ultimate object of modern Geology. Late in the past year, one of our most enlightened advocates of the extension of Middle Class Education,† in addressing a large public assembly, thus glanced at the intellectual delights of this "high point of knowledge:" "How interesting must it be to study such phenomena—to escape for a while from the works of man—to go back to primeval times, and learn how its Maker moulded the earth—how He wore down the primitive mass into the strata of its present surface—how He deposited the precious metals in its bowels—how He filled it with races of living animals, and again buried them in its depths, to chronicle the steps of creative power—how He covered its surface with its fruit-bearing soil, and spread out the waters of the deep as the great highway of nations, to unite into one brotherhood the different races of his creatures, and to bless them by the interchange of their produce and their affections!"‡

Neither of the philosophical illustrators of this grand subject has contributed more to its wide extension than the distinguished *savant* whose name heads this page, and who has the merit of having placed Geology on a true scientific basis.

Sir Charles Lyell is the eldest son of Charles Lyell, Esq., of Kinnordy, Forfarshire, who died in 1849. Sir Charles was born at Kinnordy, Kirriemuir, on the 14th of November, 1797. He received his early education at Midhurst, in Sussex, and was subsequently entered at Exeter College, Oxford, where he graduated as B.A. in 1819, and M.A. in 1821. Here he had the opportunity of attending the lectures of Dr. Buckland, Professor of Geology, and thus early acquired a taste for the science of which he has been so conspicuous a cultivator. He was destined for the Bar, and commenced practice as a barrister; but being in easy circumstances, and his tastes leading him to the culture of Geology, he ultimately abandoned the practice of the Law. On the opening of King's College, London, in 1832, he was appointed Professor of Geology, but this position he soon relinquished.

Mr. Lyell was one of the early members of the Geological Society, whose Transactions and Journal are enriched with many of his contributions. One of his earliest papers, published in the second volume of the *Transactions*, was entitled, "On a Recent Formation of Freshwater Limestone in Forfarshire, and on some Recent Deposits of Freshwater Marl; with a Comparison of Recent with Ancient Freshwater Formations; and an Appendix on the Gyrogonite, or Seed-Vessel, of the Chara." This paper was published in 1826 (the year of the Society's incorporation); and another in the same year, in Brewster's *Journal of Science*, entitled, "On a Dike of Serpentine cutting through Sandstone in the County of Forfar." In 1827 two other papers occur in the *Transactions*, one "On the Strata of the Plastic Clay Formation exhibited in the Cliffs between Christchurch Head, Hampshire, and Studland Bay, Dorsetshire;" the other, "On the Freshwater Strata of Hordwell Cliff, Beacon Cliff, and Barton Cliff, Hampshire." In this year also Mr. Lyell wrote an article in the *Quarterly Review* on Scrope's *Geology of Central France*.

These papers all indicate powers of observation of a high order; but the work upon which the scientific reputation of Mr. Lyell was mainly founded,

* Sir John F. W. Herschel. † Sir John Pakington, M.P.
‡ Sir David Brewster.

was his *Principles of Geology*. The first volume of this work appeared in January, 1830; the second in January, 1832; and the third volume in May, 1833. Such was the popularity of the *Principles*, that second editions of the first and second volumes were required before the third volume appeared. A third edition of the whole work in four volumes appeared in May, 1834; a fourth edition in 1835; and a fifth in 1837. This work treated geology from two points of view. As new editions of the several volumes were required, and materials accumulated, the author was induced to separate the two parts of the work; and in 1838 he published a volume entitled *Elements of Geology*, which contained a more full and elaborate treatment of that part of the first work devoted to the ancient history of the earth, or what may be called geology proper. A second edition of this work, in two volumes, appeared in 1841. The work was again produced in one large volume in 1851, with the title of *Manual of Elementary Geology*. A fourth edition appeared in 1852; and a fifth has since appeared. The *Principles* were again published in three volumes in 1840; and in one large volume in 1847, 1850, and 1853.*

Of these works, we quote the Author's descriptive outline, in his preface to the ninth edition of the *Principles*—"The *Principles* treat of such portions of the economy of existing nature, animate and inanimate, as are illustrative of geology, so as to comprise an investigation of the permanent effects of causes now in action, which may serve as records to after-ages of the present condition of the globe and its inhabitants. Such effects are the enduring monuments of the ever-varying state of the physical geography of the globe—the lasting signs of its destruction and renovation, and the memorials of the equally fluctuating condition of the organic world. They may be regarded as a symbolical language, in which the earth's autobiography is written. In the *Manual of Elementary Geology*, on the other hand, I have treated briefly of the component materials of the earth's crust, their arrangement and relative position, and their organic contents, which, when deciphered by aid of the key supplied by the study of the modern changes above alluded to, reveal to us the annals of a grand succession of past events—a series of revolutions which the solid exterior of the globe and its living inhabitants have experienced in times antecedent to the creation of man." Such is the author's account of the two great works, which more than any others have exercised an influence on the progress and development of geological science.

The *Principles* called the attention of geologists to the necessity of regarding the past changes of the earth's surface as resulting from causes now in operation. Aristotle's geological theory—viz., that the causes which produce geological phenomena are in constant and gradual operation—was received by the celebrated John Ray; and it has been broadly said, that "the theory of Lyell is that of Aristotle and John Ray, brought down to the present state of our knowledge." This, however, is too sweeping an assertion, notwithstanding our veneration for the Stagyrite, and his physico-theological follower, Ray, and his regard for existing agencies. We turn rather to Dr. James Hutton, who rejected all inquiry as to the beginning of the world, and gave himself up entirely to an explanation of the phenomena visible in the crust of the earth, on the principle of a continual degradation of land by atmospheric agency, the consequent formation of sedimentary strata on the bed of the sea, and the periodical compensation of these effects by the action of internal heat raising the bed of the sea, with the stratified deposits thereon. A continual destruction of the existing land through the agency of water, and an occasional uplifting of new continents from the ocean-bed—these are the most striking points of the Huttonian theory of the earth. Lyell differs from Hutton chiefly by recurring to the original form of the speculation as we may conceive it to have existed in the mind of Pythagoras or Aristotle, could either of those men have become acquainted with modern science. For, instead of the occasional occurrence of a violent upward movement of the bed of the sea, the author of the *Principles of Geology* contends for a continual compensation among the agencies of nature, the perfect equality of modern and ancient physical forces, and the possibility of explaining all, even the grandest, of ancient geological phenomena by causes now acting, and acting with their present intensity.

*Memoir in Knight's *English Cyclopædia*, to which the Editor of the present Sketch is largely indebted.

The *Principles*, however, met with great opposition from those who imagined that the work interfered with the authoritative declarations of Scripture. Lyell's own University was most decided in its opposition to the new views, although its able Professor of Geology was not so: the theologian has, however, admitted the necessity of adapting his opinions to the requirements of correct reasoning and undoubted facts.

In 1841 and 1845, Mr. Lyell made two visits to North America, and delivered courses of lectures before the scientific institutions of that country. His *Travels* were published in two separate works. The first was entitled *Travels in North America, with Geological Observations on the United States, Canada, and Nova Scotia*, 2 vols., 8vo, with a geological map. These volumes contain an account of personal incident, as well as popular descriptions of the geology of the district visited. The author specially describes the educational institutions of America, and strongly insists on their superiority to our own similar institutions, on account of the extensive cultivation of the natural sciences. In his second journey he more particularly visited the Southern States, and records in his work his personal adventures, together with an account of the geology of the districts through which he passed. This work is entitled, *A Second Visit to the United States*.

Previous to these journeys, the Author had travelled on the continent of Europe, and made himself acquainted with the most prominent points of its geology. In the papers on these studies, which he has published in the *Transactions* of the Geological and other Societies, he has more especially illustrated the great Tertiary beds of Europe, to which he has all his life devoted more or less attention, and by his labours principally given the definite character which these formations assume in the history of the earth's surface; and the high value of these papers may be estimated from the statement that they "constitute a mass of facts and conclusions on which much of the present science of geology rests."

The Author's chief aim in his travels in America was to examine the geology of the New World. His papers on this subject are very numerous and important, and are as follows:—"On the Carboniferous and Older Rocks of Pennsylvania;" "On the Stigmaria Clay in the Blossburg Coal Field, Pennsylvania;" "On the Recession of the Falls of Niagara;" "On the Tertiary Formations, and their connexion with the Chalk in Virginia, and other parts of the United States;" "On the Fossil Footprints of Birds, and Impressions of Rain-drops in the Valley of the Connecticut;" "On the Ridges, Elevated Beaches, Inland Cliffs, and Boulder Formations of the Canadian Lakes and Valley of St. Lawrence;" "On the Tertiary Strata of the Island of Martha's Vineyard in Massachusetts;" "On the Geological position of the Mastodon Giganteum, and associated fossil remains at Bigbone Lick, Kentucky, and other localities in the United States and Canada;" "On the Upright Fossil Trees found at different levels in the Coral Strata of Cumberland, Nova Scotia;" "On the Coal Formations of Nova Scotia, and on the age and relative position of the Gypsum and accompanying Marine Limestone;" "On the Cretaceous Strata of New Jersey, and other parts of the United States bordering the Atlantic;" "On the probable Age and Origin of a bed of Plumbago and Anthracite occurring in Mica Schist, near Worcester, Massachusetts;" "On the Miocene Tertiary Strata of Maryland, Virginia, and of North and South Carolina;" "On the White Limestone, and other Eocene or Older Tertiary Formations of Virginia, South Carolina, and Georgia;" "On the Coal Fields of Tuscaloosa, Alabama;" "On the evidence of Fossil Footprints of a quadruped allied to the Cheirotherium in the Coal Strata of Pennsylvania;" "Observations on the Fossil Plants of the Coal Field of Tuscaloosa, Alabama, with a description of some species by C. I. F. Bunbury;" "On the Delta and Alluvial Deposits of the Mississippi, and other points in the Geology of North America observed in the years 1845-46;" "On the Coal Fields of Alabama;" "On the Newer Deposits of the Southern States of North America;" "On the Footmarks discovered in the Coal Measures of Pennsylvania;" "On the Structure and probable Age of the Coal Field of the James River, near Richmond, Virginia;" "On the Relative Age and Position of the so-called Nummulite Limestone of Alabama." These papers were published in the *Proceedings* and *Transactions* of the Geological Society, *Reports of the British Association*, and *Silliman's Journal of American Science*.

Sir Charles Lyell received the honour of knighthood on account of his

scientific labours, in 1848; and in 1855, the University of Oxford, his *Alma Mater*, honoured itself by conferring on him the title of D.C.L. In 1836, he was elected President of the Geological Society, and again in 1850. Sir Charles Lyell is also one of the most active members of the British Association for the Advancement of Science; many of his papers are published in the Society's *Proceedings;* and his presence at its meetings has contributed much to the interest and value of the labours of the Geological Section of the Association.

With regard to "the Origin of Species"—or the notion that the various forms of animals and plants which inhabit or have inhabited the surface of the earth, are modifications of one common form, and that the more complicated forms have grown out of, or been developed from the simpler forms of animal and vegetable life—Sir Charles Lyell not only opposes this theory, but denies that in the history of the strata there is any evidence that the lowest forms of animals were created first. The only fact he admits favouring the hypothesis of development is the late appearance of man on the earth. Regarding negative evidence as no support to any theory of process, he sees no reasonable objection to the anticipation that the highest forms of *Mammalia,* except man, should be found in the lowest Silurian rocks.

Sir Charles Lyell has just completed an elaborate work upon a subject which is occupying the minds of the most distinguished geologists of the day, as well as a large portion of the reading public generally. As this work is scarcely printed, we can here do but little more than give its title, which is as follows:—"On the Geological Evidences of the Antiquity of Man; or, an Inquiry into the Age of Human Bones and Works of Art preserved in Peat Mosses and Shell Mounds of Denmark, the Swiss and Irish Lake-Dwellings, &c. &c., as compared with those found in Caverns and Old Alluvial Deposits coeval with the Remains of Extinct Mammalia: also Observations on the Earliest Known Date of the First Appearance of Man and that of the Existing Fauna and Flora, and the age of both as compared to that of the Glacial Period in Europe, &c., with concluding remarks on the Origin of Species."

The following are the heads of the several chapters of the work:—1. Introduction. 2. Recent Period—Danish Peat and Shell Mounds—Swiss Lake-Dwellings. 3. Fossil Human Remains and Works of Art of the Recent Period. 4. Post-Pliocene Period—Bones of Man and Extinct Mammalia in Belgian Caverns. 5. Post-Pliocene Period—Fossil Human Skulls of the Neanderthal and Engis Caves. 6. Post-Pliocene Alluvium and Cave Deposits, with Flint Implements. 7 and 8. Peat and Post-Pliocene Alluvium of the Valley of the Somme. 9. Works of Art in Post-Pliocene Alluvium of France and England. 10. Cavern Deposits, and Places of Sepulture of the Post-Pliocene Period. 11. Age of Human Fossils of Le Puy and of Natchez. 12. Antiquity of Man relatively to the Glacial Period, and to the Existing Fauna and Flora. 13 and 14. Chronological Relations of the Glacial Period and the Earliest Signs of Man's Appearance in Europe. 15. Extinct Glaciers of the Alps, and their Chronological Relation to the Human Period. 16. Human Remains in the Loess, and their Probable Age. 18. Post-Glacial Dislocations and Foldings of Cretaceous and Drift Strata in the Island of Moën, in Denmark. 19. The Glacial Period in North America. 19. Recapitulation of Geological Proofs of Man's Antiquity. 20. Theories of Progression and Transmutation. 21. On the Origin of Species by Variation and Natural Selection. 22. Objections to the Hypothesis of Transmutation considered. 23. Origin and Development of Languages and Species compared. 24. Bearing of the Doctrine of Transmutation on the Origin of Man, and his Place in the Creation.

From this list may be formed some idea of the comprehensive grasp of the forthcoming Work; and with the Author's characteristic regard to accuracy of statement and well-considered deduction and reflection, these "Geological Evidences" must command a large share of the attention of men of science, as well as of the legion of readers.

Sir Charles Lyell was married, in 1832, to the eldest daughter of Leonard Horner, Esq., F.R.S.

The accompanying portrait of Sir Charles Lyell is engraved from a crayon picture by Richmond.

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THE

YEAR-BOOK OF FACTS.

Mechanical and Useful Arts.

THE METROPOLITAN SUBTERRANEAN RAILWAY.

THIS new Railway, which was fully described in the *Year-Book of Facts*, 1862, pp. 69-71, was opened on Saturday, January 10, 1863; during the first week, the daily traffic averaged 80,000 passengers; on the first Sunday, the numbers were 38,000. The underground portions of the line are, to a great extent, free from the annoyances usually experienced in railway tunnels. The engine-drivers, for their own comfort's sake, not less than for that of the passengers, pay great attention to the working of the engines. No persons suffer more in tunnels from the sulphurous fumes and products of combustion from the furnaces than the drivers and stokers, and when so large a portion of their time is passed underground they are naturally very careful in the management of their fires, and as far as possible avoid feeding them with fresh fuel while in the tunnel. In spite, however, of all their precautions, a certain amount of sulphurous vapour will be given off from the engines, and the drivers complain of pains in the head from working the trains. The tanks below the engines, which are used as condensers, have been found much too small, and they will require to be replaced by larger ones. The steam from the cylinders having done its work, passes into these tanks, which in theory ought to have a constant supply of cold water, but the only time when the water is really cold is at the commencement of each journey. By the time the trains have passed through the longer or central tunnel of the line the water in the condenser is brought to boiling heat, or nearly the same temperature as that in the boiler. As soon as this degree of heat has been attained it is necessary to open the valves and let off the steam, for if there were no escape provided, the condensers would be as liable to explode as a boiler without safety-valves. The steam is thus often discharged into the tunnel; it rapidly condenses, however, and causes no serious annoyance. The sulphurous fumes from the fire-boxes and chimneys are not, however, so easily got rid of. 'This inconvenience has, however, been greatly exaggerated.

The Gower-street station, at which the men were stationed, is provided with glazed openings from the gardens in front of the houses. The simple remedy of opening these windows has since been adopted, and no inconvenience is now felt at this station. At the Baker-street station the glass has also been removed from the side apertures which admit light into the stations, and the tower at

Portland-road has been made to do duty as a ventilating shaft. From King's-cross to Farringdon-street the engines are worked on the usual high-pressure system, as, with the exception of the Coppice-row tunnel of 600 yards in length, this portion of the line is an open cutting. This short section of tunnel has one air shaft, and the smoke and steam from the engine produce no very disagreeable effect in that short run. The same system of working at high pressure is adopted at the Paddington end of the line, between the Bishop's-road and the Edgeware-road stations. It is only, therefore, between the Edgeware-road and King's-cross, in the unbroken length of tunnel, that the plan of condensing is adopted, and in running this distance, as we have said, the waste steam raises the water to boiling point. Two things are absolutely necessary,—to increase considerably the speed of the trains, and enlarge the capacity of the condensers. Both of these improvements will be carried out. We quote these details from the *Observer*.

In the *Times* report we read:—"The whole line was constructed for five-minute trains, and the stations purposely so placed that with trains running at this interval apart there would always be two clear stations between each—a distance that would render collision accidents almost impossible. In the same way the system of mechanical signals was devised at a considerable outlay of trouble and ingenuity. These signals are about the best and most efficacious of this kind that have ever been invented. They are so arranged that while any signal-man can put them on to "danger" they cannot possibly be taken off but at the station to which the train is going. Thus, with a train starting at the Paddington terminus, the signalman puts on the danger signal to prevent others following, and in the act of putting it on the "points" which give entrance to the line are shut and locked, so that it becomes mechanically impossible for another train to enter the line till the one that has started has passed the station ahead, from which point only can the danger signal behind be removed. These signals are not used now the line is being worked by the Great Western Company by telegraph, but they must come into use as soon as the number of trains is increased, arrangements for which are already being made. The first improvements in this respect will be by the introduction of express trains, to run through without stopping, in the morning to the city, and in the afternoon from it. The plan of lighting the carriages by gas has been found to work admirably both as regards economy and power of illumination. The gas reservoirs on the roof of each carriage can be filled from the stand-pipes in two minutes and a half, and one filling lasts nearly three hours. As might be expected from the success which has so far attended the opening of the first part of the line, it is intended to lose no time in pushing its main length into the very heart of the city near Moorgate-street. This portion from the terminus at Farringdon-street is a little over three-quarters of a mile, and will be made in two branches; one intersects Holborn-hill, or rather

Skinner-street, and continues its course due south under the site of the old Fleet Prison to effect a junction with the Chatham and Dover line, which is to cross the Thames at Blackfriars. The other, and the more important branch,—in fact, the main line, is to be continued in a cutting through the ground north of Smithfield and south of Charterhouse-square, beneath the Barbican, into Finsbury, terminating in an ample station, nearly an acre in extent, at the back of Moorgate-street, on the west side. The whole of this latter branch is to be an open cutting varying from 20 to 25 or 30 feet deep and of great width, as this portion is to be laid for four lines of mixed or double gauge rails. At all the intersections of streets along the cutting—and these occur constantly—the bridges that will continue the roadway over the line are intended to be made of nearly three times the usual width, in order to allow of the erection of shops and warehouses on either side of the road, and by renting or selling these freeholds the company hope to reimburse themselves for a considerable share of their outlay in the construction of the line.

INSTITUTION OF CIVIL ENGINEERS.

THE Council of the Institution of Civil Engineers have awarded the following premiums :—

1.—A Telford Medal, the Manby premium, in books, and a Stephenson Prize of 25 guineas, to Charles Augustus Hartley, M. Inst. C.E., for his "Description of Delta, and of the Works recently executed at the Sulina Mouth of the Danube."

2.—A Telford Medal and a Miller Prize of 15 guineas, to John Henry Muller, of the Hague, for his paper "On Reclaiming Land from Seas and Estuaries."

3.—A Telford Medal, and a Miller Prize of 15 guineas, to John Paton, M. Inst. C.E., for his paper "On the Sea Dykes of Schleswig and Holstein, and on Reclaiming Land from the Sea."

4.—A Telford Medal, to James Abernethy, M. Inst. C.E., for his "Description and Illustrations of the Works at the Ports of Swansea, Silloth, and Blyth."

5.—A Telford Medal, to John Bailey Denton, M. Inst. C.E., for his paper "On the Discharge from Underdrainage, and its Effect on the Arterial Channels and Outfalls of the Country."

6.—A Watt Medal, to Joseph D'Aguilar Samuda, M. Inst. C.E., for his paper "On the Form and Materials for Iron-plated Ships, and the Points Requiring Attention in their Construction."

7.—A Council premium of books, to James Brunlees, M. Inst. C.E., for his paper on "Railway Accidents, their Causes and Means of Prevention."

8.—A Council premium of books, to Captain Douglas Galton, R.E., F.R.S., Assoc. Inst. C.E., for his paper on "Railway Accidents, showing the Bearing which existing Legislation has upon them."

9.—A Council premium of books, to Henry Charles Forde, M. Inst. C.E., for his paper on "The Malta and Alexandria Submarine Cable."

10.—A Council premium of books, to Charles William Siemens, F.R.S., M. Inst. C.E., for his paper "On the Electrical Tests employed during the Construction of the Malta and Alexandria Telegraph, and on Insulating and Protecting Submarine Cables."

11.—A Council premium of books, to James Atkinson Longridge, M. Inst. C.E., for his paper on "The Hooghly and the Mutla."

12.—A Council premium of books, to James Oldham, M. Inst. C.E., for his paper "On Reclaiming Land from Seas and Estuaries."

PATENTS FOR INVENTIONS.

In the year 1861 there were 3276 applications for provisional protection of inventions, but above a third of them were allowed to lapse, and only 2047 patents were actually passed; and but about a tenth of these probably will be renewed at the end of their third year by the further payment of 50*l.*, and again at the end of the seventh year by payment of a further 100*l.* For, of the first 4000 patents passed since the alteration of the law in 1852, nearly 70 per cent. were allowed to lapse at the end of the third year, and nearly 90 per cent. became void at the end of the seventh year by nonpayment of the further 100*l.* Of the 1876 sealed in the year 1854, only 142 paid the 100*l.* duty for continuing them beyond 1861. The fees are high, but it is considered that lower fees would embarrass the public with an increased number of useless and speculative patents, and with many taken merely for advertising purposes. Of the income of the year the Attorney and Solicitor General, and their clerks, take about a tenth; the public purse (in stamps) nearly a fifth; and, after paying office expenses and the cost of printing and stationery, there is now an accumulation of surplus income amounting to 129,000*l.*, which will probably be applied in building a patent office, public library, and museum, which will constitute a historical and educational institution for the benefit and instruction of the skilled workmen of the kingdom. Exact models of machinery are to be exhibited in the subjects showing the progressive steps of improvement. For example, a series of exact models of machines, or in the machine itself, each important invention and improvement, making a series from the first experimental steam-engine that drove a boat of two tons burden, which engine is now in the Museum, to the powerful machinery of the present day.

[We quote the above *précis* from the *Times*, in which journal unusual attention has been paid to the general scientific information during the past year. We record this fact with pleasure—not only in acknowledgment of the great assistance derived from the *Times* in the compilation of this *Year-Book*, but also as one of the reading community, to whom this prompt and accessible register is of great value and importance.—*Ed. Year-Book of Facts.*]

GAS-LIGHTING THE CITY OF LONDON.

At a meeting of the Commissioners of Sewers, held in January, 1863, a letter was read from the Directors of the Great Central Gas Company relative to the public lighting. Their attention, they said, had been called to the Report of experiments made by the engineer of the Commissioners in December last, for the purpose of ascertaining the quantity of gas supplied to the public lights; and, being surprised at the apparent results, the Directors instructed their engineers and chief inspector to make experiments upon the particular lamps specified in that Report, with the view of testing its accuracy, such lamps remaining in precisely the

same condition as when experimented upon by the officers of the Commission. The results of those experiments showed the average consumption of the whole to be 3·66 cubic feet of gas per hour. Classified into streets, the consumption in Farringdon-street was 3·08 average an hour; Fleet-street, 3·14; Skinner-street, 3·6; Snow-hill, 3·6; Well-court, 5·4; Upper Thames-street, 3·90; and Bucklersbury, 3·90. The pressure at which those burners were tried was taken from 9 p.m. to 11 p.m., and the pressure on the mains at that time was one-tenth of an inch less than the average pressure during the hours of lighting. From those results the Directors believe that, instead of the public lamps in the southern division of the city being supplied with less gas than the quantity contracted for, the supply was not less than 20 to 25 per cent. more than such contract quantity. The letter was referred to the General Purposes Committee for consideration and report, as was also an application from the City Gas Company to lay down a 24-inch gas main from their works near Blackfriars-bridge to the Minories by way of Ludgate-hill, St. Paul's-churchyard, Cannon-street, and Eastcheap, in order that the Committee might prescribe the hours of the day in which the work ought to be done, with the least inconvenience to the public and interruption of the traffic. A novel application was made by Deputy Bower with respect to a public lamp in a part of Billingsgate, where upwards of 200 years ago a citizen fell at night and broke his leg, and afterwards bequeathed a sum of 4*l*. a year for the maintenance there of a public light at night for all time. The money had been regularly paid for two centuries, and, since the introduction of gas, to a gas company charged with lighting the district, and who had kept up the light. The application now was for a new lamp in place of one which had become ruinous from age. It was granted. (See, also, page 84 of the present volume.)

FIRES IN THE METROPOLIS IN 1862.

CAPTAIN SHAW, Superintendent of the London Fire Brigade, has made his annual report to the committee of the Associated Insurance Offices on the number and causes of fires occurring in the metropolis during the past year. The document is full of interesting statistics, from which the following facts may be gathered:—The total number of "calls" was 1543, of which 109 proved to be only chimneys on fire, and 1303 were fires of which 33 resulted in total destruction of buildings, &c., 238 in serious damage, and 982 in slight damage. Compared with the preceding year the fires of 1862 show an increase of 120, and compared with an average of the previous 29 years the increase is 497. These returns do not include ordinary calls for chimneys on fire, which may be roughly estimated at 3000. The totally destroyed list (33), compared with that of 1861, shows a decrease of 20; and compared with the average proportion of the 29 previous years the decrease is 12. Of the premises destroyed six were over two miles from the nearest station, three were over three miles, three

over four miles, one over seven miles, and one over ten miles. Ten were completely on fire and three others nearly destroyed before the arrival of the engines. Two were destroyed by explosion, and of the remainder the imperfect construction of the buildings and the combustible materials of which they were composed rendered the extinction of the fires impossible until great destruction of property had taken place. Referring to the introduction of land steam fire-engines, Captain Shaw states that their superiority has now been proved beyond the possibility of dispute. Many serious and threatening fires have been successfully controlled at an early stage by these engines, one great advantage of which is the diminution of damage by water, which is driven with such force by steam that almost every drop does its duty and very little is wasted.

Telegraphic communication has now been established between the central station in Watling-street and the other principal stations. By this means the necessary force of men and engines can be despatched to any required spot in a much shorter time than formerly, and though it has only been a few weeks in operation, it has already been the means of saving a large amount of property. Fourteen firemen have recently been added to the strength of the establishment, which now numbers 130 men. The casualties during the year have been 38, thus enumerated:—Cuts and lacerated wounds, 12; injury from falls at fires, 7; severe sprains, 6; broken arm, 1; dislocation of kneecap, 1; scalds, 2; slight accidents, 7; amputation of finger—accident at drill, 1; concussion of brain—accident at gymnastics, 1. The arduous character of the service is shown by the fact that, in addition to the above accidents, there have been 58 cases of ordinary illness, making a total of 96 cases under the surgeon's care during the year. The monthly summary of fires shows that there occurred in January, 106; in February, 112; in March, 92; in April, 111; in May, 106; in June, 92; in July, 121; in August, 136; in September 119; in October, 86; in November, 100; and in December, 122; total, 1303. Of this number 494 occurred from unknown causes. Of the rest, 198 happened through the careless use of candles; from gas, 124; from defective flues, 96; from lucifer-matches, 15; from smoking tobacco, 24; from sparks from fire, 95; from spontaneous ignition, 17; from overheating stoves, 28; from hot ashes, 19; from airing linen, 10; from children playing with fire, 27; from intoxication, 9; from naphtha, 2; and the remainder from various causes. After paying a well-merited tribute to the zeal, steadiness, and general good conduct of all ranks of the establishment under his command, Captain Shaw concludes his report with the following comparative table of fires in several of the principal cities of Europe and the United States:—

Philadelphia (approximate yearly average)	363
New York „ „	370
Berlin „ „	260
Baltimore „ „	255

Brooklyn (approximate yearly average)			140
Hamburg	„	„	244
Boston	„	„	160
Dublin	„	„	120
Charleston	„	„	59
Paris (in 1862)	„	„	244
Manchester	„	„	206
Liverpool	„	„	176
Edinburgh	„	„	101
Birmingham	„	„	95
Bristol	„	„	89
Belfast	„	„	31
London	„	„	1303

PARIS PERMANENT UNIVERSAL EXHIBITION.

A VAST building is rising in one of the suburbs of Paris, under the auspices of the Emperor, although (as is very unusual in France) without a State guarantee; the enterprise being like the Crystal Palace at Sydenham, undertaken by a company. The estimated cost of the building is 600,000*l.*, the whole of which has been subscribed in France; and the object of the scheme is to found in Paris a spacious place of resort for producers, dealers, and customers, from all parts of the world, where commodities may be compared and purchased under one roof, an arrangement which will afford facilities to all parties. The shareholders will be reimbursed by the rentals charged to exhibitors, and the public will be admitted free on at least five days of the week, it being thought that an entrance-fee deters many from entering a place.

The palace (at Auteuil) is situated on an irregular-shaped plot of ground, bounded on one side by the new railway, on another by the road to St. Cloud, and flanked by the ramparts.

The plan of the edifice has been adapted to meet the peculiarities of the site, and the uncovered ground will be laid out in parterres. The main building will consist of an open nave running north and south, presenting a clear and uninterrupted vista of 1050 ft. long, 130 ft. wide, and 110 ft. to the crown of the semicircular roof, which springs at a height of 35 ft. from the floor-line. This nave will be intersected by a transept of equal width and height, by 50 ft. in length, above which a lofty dome of elegant contour will rise to a total height of 345 ft. On each side of the nave there will be aisles 100 ft. in width, and again, on the west side, two supplementary aisles of equal width, but of varied length, planned in accordance with the site. Over all these aisles, at a height of 25 ft. from the ground, galleries will be constructed. At the south end, quite detached, and yet connected with the main building by corridors, will be a polygonal saloon, no less than 222 ft. in diameter, which will be the largest covered assembly-room in the world of that form. The central height of this saloon will be 115 ft., and, with its gallery all round, it is calculated to hold 10,000 persons.

A machinery annexe, 600 ft. long and 100 ft. wide, will occupy the north-east corner of the ground; and near the music saloon will be erected a winter garden, or rather two buildings of iron

and glass used as winter gardens—one being semicircular, 80 ft. in diameter; the other a parallelogram, 160 ft. long and 26 ft. broad.

The architect is M. Liandier; the contractor, Mr. Edwards; and the iron castings are being made in Glasgow by Messrs. T. Eddington and Son. (See a well-engraved view of the building in the *Illustrated London News*, August 30, 1862.)

PARIS MANUFACTURES.

A LETTER in the *Times* states that the Paris manufacturers of bronze ornaments returned from the International Exhibition with orders so numerous that, after having engaged all the unemployed artists and mechanics, they found it necessary to prolong the ordinary period of work by three hours a day. The increased demand for gold and silver ornaments, fine porcelain, and printed stuffs for export to Belgium, Holland, Spain, Italy, Portugal, and South America, has given much impulse to all these trades. The International Exhibition has conferred immense benefit not only on the manufacturers of bronze articles, but likewise on French gunmakers, who at present export arms to the amount of 10,000,000f. annually. The Parisian shoemakers say that the English beat them in the manufacture of men's boots and shoes. It would be vain for them to deny the fact, for there are several shops in Paris established for the sale of men's boots and shoes of English manufacture. The Parisians, on the other hand, boast that none can compete with them in the manufacture of ladies' boots and shoes. They add, that they export an enormous quantity to England and her colonies, to Russia, and the far East. They export a second quality to the French West Indies, Brazil, and Chili. The 25,000 cabinet-makers in the Faubourg St. Antoine pretend that no country can compete with them in the form or delicacy of the articles manufactured by them, the suitableness of each part for the purpose for which it is intended, the excellence of the sculpture, the care with which they avoid every useless ornament of great expense but of doubtful taste with which the produce of other countries is overloaded. They assert, moreover, that the English artists have for some time past engaged many of their best hands, and that at this moment such tools as are used by the artisans in Paris are made here to be exported to London.

Although the number of pianos manufactured in England and Germany far exceeds those produced in France, the upright pianos exported from France exceed those from either England or Germany. In the manufacture of ribands, of which the value produced throughout France is estimated at 130,000,000f. annually, Paris comes after St. Etienne and St. Chamond. The export of ready-made clothes from France commenced about twenty years ago: one-fifth consists of old clothes exported by three houses who confine themselves to that trade; the principal markets for the sale of ready-made clothes are found in Algeria, Belgium, Germany, Switzerland, and Italy.

MECHANICAL PROPERTIES OF PROJECTILES.

DR. FAIRBAIRN has read to the British Association a paper "On the Results of some Experiments on the Mechanical Properties of Projectiles." He commenced by stating that, in the investigations which had taken place with regard to projectiles and armour-plated ships, one great difficulty that had arisen was to get good plates of sufficient thickness, and vessels of sufficient tonnage to carry those plates. It appeared that they were limited to plates of five inches in thickness; with plates heavier than that, a ship would not be what was technically called "lively." He had attended the experiments at Shoeburyness from the commencement, and they had reference to the force of impact. He stated the results of the more recent experiments, not yet published.

The first series of these important experiments had reference to the quality of the plates and the properties of the iron best calculated to resist impact. There were three qualities required: first, that the iron should not be crystalline; but secondly, that it should be of great tenacity and ductility; and thirdly, that it should be very fibrous. The mean statical resistance to crushing of the two flat-ended specimens of cast-iron is 55·32 tons per square inch. The mean resistance of the two round-ended specimens is 26·87 tons per square inch. The ratio of resistance, therefore, of short columns of cast-iron with two flat ends to that of columns with one flat and one round end is as 55·32 to 26·87, or as 2·05 to 1—an extremely close confirmation of Prof. Hodgkinson's law. Applying this same rule to the steel specimens, it would appear that the flat-ended shot should have sustained a pressure of 180 tons per square inch before fracture. In the experiment it actually sustained 120 tons per square inch without injury, excepting a small permanent set. In the experiments with cast-iron, the mean compression per unit of length of the flat-ended specimens was ·0665, and of the round-ended ·1305. The ratio of the compression of the round-ended to the flat-ended shot was, therefore, as 1·96 : 1, or nearly in the inversed ratio of the statical crushing pressures. Applying this law to the case of the steel flat-ended specimen, it may be concluded that the compression before fracture would have been only ·058 per unit of length. The determination of the statical crushing pressure of the flat-ended steel shot as 180 tons per square inch and its compression as ·058 is important, on account of the extensive employment of shot of this material, size, and form in the experiments at Shoeburyness. In the case of the lead specimens, the compression with equal weights was the same whether the specimen were at first round-ended or flat-ended. This is accounted for by the extreme ductility of the metal and the great amount of compression sustained. In regard to the wrought-iron specimens, it may be observed that no definite result is arrived at, except the enormous statical pressure they sustain, equivalent to 78 tons per square inch of sectional area, and the large permanent set they then exhibit :—

	Statical Resistance in Tons per Square Inch.	Dynamical Resistance in Foot lb. per Square Inch.
Cast-iron, flat-ended	55·32	776·8
Cast-iron, round-ended	26·87	821·9
Steel, round-ended	90·46	2515·0

In the experiments on the wrought-iron specimens, the flat-ended steel specimens, and the lead specimens, no definite termination was arrived at, the material being more or less compressed without any fracture ensuing. The mean resistance of the specimens of cast-iron is 800 foot lb. per square inch; that of the specimen of steel is 2515, or rather more than three times as much. The conditions which would appear to be desirable in projectiles, in order that the greatest amount of work may be expended on the armour-plate are—

1. Very high statical resistance to rupture by compression. In this respect, wrought-iron and steel are both superior to cast-iron; in fact, the statical resistance of steel is more than three times, and that of wrought-iron more than two-and-a-half times, that of cast-iron. Lead is inferior to all the other materials experimented on. 2. Resistance to change of form under great pressures. In this respect hardened steel is superior to wrought-iron. Cast-iron is inferior to both. The shot which would effect the greatest damage to a plate would be one of adamant, incapable of change of form. Such a shot would yield up the whole of its *vis viva* to the plate struck; and, so far as experiment yet proves, those projectiles which approach nearest to this condition are the most effective. The President stated that steel shots might be made at a comparatively small cost. Mr. Bessemer had told him, that if he had a large order he could produce steel shots at a little more than the price of iron; but if the ingots as cast had to be rolled or hammered to give them fibre, they would cost near 30*l*. a ton, instead of 8*l*. or 10*l*. per ton.

Mr. J. Nasmyth inquired whether chilled cast-iron flat-headed shot had been tried? The process of chilling cast-iron was very simple and inexpensive. If chilled flat-ended cast-iron shot had not been tried, it was very desirable it should be. Dr. Fairbairn said they had not been tried; but he believed that shot thus made being hardened to a certain depth, having its velocity the same, would, in striking the object, break as if it had not been hardened at all. However, he would have experiments made; and he hoped that before the next meeting of the Association the matter would be proved experimentally.—*Athenæum*, No. 1825.

ON PROJECTILES.

MR. T. ASTON has read to the British Association a paper "On Projectiles with regard to their Power of Penetration." After alluding to the interest with which the contest between artillery and armour-plates has been watched by the country, he explained what was the actual condition of this important question so late as May last, by quoting statements which had been made in Parliament and elsewhere, that after all the vast expenditure upon our new artillery, the Navy of England is compelled to arm herself with the old smooth-bore; and that is the best gun the Navy actually possesses, though admitted to be so inefficient. Such being the state of the question a few months ago, Mr. Aston proceeded to consider, first, the reason why the artillery hitherto employed

in the service (including rifled guns and smooth-bores) has always failed to make any impression on the plated defences at ordinary fighting range; and, secondly, by what means artillery science has lately reconquered its lost ground. Three conditions were laid down as necessary to enable artillery to attack successfully armour-plate defences:—1st, the projectile must be of the proper form; 2nd, of the proper material; and, 3rd, be propelled from a gun able to give it the necessary velocity. The artillery of the Ordnance Committee failed because they utterly neglected the first two conditions, and had recourse to the brute force of the smooth-bore for the third. The expression accepted as representing the penetrating power of shot was "velocity squared multiplied by weight;" but the form of the shot and the material were conditions altogether omitted from the expression; and the importance of the omission will be obvious at once if an analogous case—say a punching machine employed to perforate wrought-iron plates—be taken. What would be the result if the punch which is made of suitable shape and material were removed, and a round-headed poker of brittle cast-iron or soft wrought-iron were substituted in its place? The great importance of velocity was conceded at once—it is a *sine quâ non* condition; but there has been great misconception in supposing that the old smooth-bore gives a greater initial velocity than the rifled gun, as the results obtained would show. The average initial velocity of the 68-pounder is, in round numbers, 1600 feet per second, with a charge of powder one-third the weight of the shot, the length of the shot being, of course, one calibre. Sir W. Armstrong stated, that with a charge of powder one-quarter the weight of the shot, he obtained with his rifled gun an initial velocity of 1740 feet per second. He did not state the length of his projectile. Mr. Whitworth, with a projectile two calibres long, obtains an initial velocity of 1900 feet per second; and with a projectile one calibre long, like that of the smooth-bore, an initial velocity of 2300 feet per second: being greater than that of the smooth-bore in the proportion of 23 to 16. The following table shows the actual results obtained by various guns:—

Gun.	Range.	Projectile.	Powder Charge.	Penetration into Armour-Plate.
Armstrong 110-pounder	200	110 lb. solid	14 lb.	1½ to 2 inches
68-pounder smooth-bore	200	68 lb. solid	16 lb.	2¼ to 3 inches
Whitworth 70-pounder	200	70-lb. shot and shell	12 lb.	Through plate and backing
Whitworth 120-pounder	600	130-lb. shell	25 lb.	Through plate and backing

The first two results show that the Armstrong rifle gun is a worse compromise than the old gun it was intended to supersede. It is worthy of notice, that the velocity of the Whitworth heavy projectile, after traversing 600 yards (a good fighting range), was 1260 feet; being 50 feet greater than the initial velocity of the

Armstrong projectile, which is 1210 feet at the muzzle of the gun. The total results in respect of penetration being so decidedly in favour of Whitworth, it follows that he has adopted the best compromise, by combining all three necessary conditions of proper form and material of projectile and sufficient velocity. That the velocity, though perhaps at the muzzle of the gun slightly below that of the smooth-bore, is sufficient when combined with proper form and material of projectile, is shown by the penetration result, which in the case of the Whitworth is through and through both armour-plate and backing; in the case of the smooth-bore is barely through half the armour-plate; and in the Armstrong is not half through. The form of projectiles, both shot and shell, employed by Mr. Whitworth for penetrating armour-plates, was then described. The material of which the projectile is composed is what is termed homogeneous iron—combining the toughness of copper with the hardness of steel. It undergoes a carefully regulated process of annealing. The same metal is used for the Whitworth field-guns; and practical improvements now enable it to be worked in masses of any requisite size, whose quality may be henceforth depended upon with certainty. Mr. Whitworth is therefore now making his heavy ordnance with both interior tubes and outer hoops of homogeneous metal of the improved manufacture; so that the guns will be constructed throughout of one uniform metal, without any welding at all. Experience justifies the expectation that they will be free from the objections which it is well known are inherent in all welded guns, and be fully able to resist the severe and searching strain that is sure sooner or later to disable a gun built up of forged coiled tubes, if it be called upon to do its full work by discharging heavy projectiles at efficient velocities.

Mr. Nasmyth said the steam-ram was an old subject with him. A plan was proposed by him to the Admiralty so long ago as 1845. He thought the more destructive you can make the attack on your adversary the better. It was not right to be torturing your enemy by drilling numerous small holes in him; it was like taking a whole day to draw a tooth. His idea was to make one large hole and sink the ship at once with the enemy. It was a question of momentum. The first practical ram was the *Merrimac;* but the Southerners made a mistake in giving her a sharp end: it should be blunt; and such was the original plan of the author, nor had he seen any reason to alter his views. The vessel must present as low an angle as possible to turn shot; but she must also have strength in the direction of her length, and use the utmost possible amount of steam to get velocity; and, to meet the objection that the impact might destroy the engines, which he did not anticipate, he would place the engines on a slide, with buffer arrangements. With such a vessel he would dash into the *Warrior* as into a bandbox. The plates would be crushed at once. He hoped the Admiralty would devote a thousand pounds or two to try the effect of a ram against some old hulk, then the *Trusty* with armour-plates, and afterwards

against the *Warrior* herself; and he thought it would be best to knock a hole in her ourselves, in preference to having it done by an enemy.

Mr. Webster hoped that in the discussion they would not omit the question, brought before the Section by Mr. Atherton, of unsinkable ships.* It was quite clear from the late experiments that ships could not withstand the attack of guns, and there was a reason why we should give some attention to other matters of ship architecture than the mere attempting to defend them by armour-plates against shot.

Admiral Sir E. Belcher observed that in 1818 he had urged a plan of unsinkable ships to Sir Robert Seppings by shutting down the hatches and using the pumps to pump in air; but this was objected to, on the ground that it was necessary to have an opening to keep the timbers sound. He advised water-tanks as a backing to the sides of ships, believing that such an arrangement would withstand even Mr. Nasmyth's ram.

Mr. R. W. Woollcombe explained the nature of his projectile, by means of which he got rid of the friction caused by rifling, with no more windage, the projectile being a disc travelling in a direction perpendicular to its axis of rotation.

Mr. G. P. Bidder, jun., observed, that with a smooth-bore the balls go accurately for a short distance, but afterwards they diverge in uncertain directions; and this he showed must be the case as well with Mr. Woollcombe's shot as with an ordinary smooth-bore shot.

Capt. Blakeley said that Mr. Aston had told them that Mr. Whitworth was beginning to use homogeneous metal for the inside and the outside of his guns; and he (Capt. Blakeley) would encourage him to use this, as he had for several years past used it with great advantage. He had made guns, in use abroad, of large size, which would throw rifle 600 lb. shot with 80 lb. of powder. The Spaniards had such guns; and he thought the English Government ought to give some encouragement for trials of every kind of gun as well as rams.

Mr. J. Scott Russell said at the last meeting it was ascertained that 4½-inch plates and 18 in. of wood would beat the gun; but the late experiments had shown that we have no navy if you keep wooden ships with iron-plates. Sir W. Armstrong fired our wooden ships, and Mr. Whitworth had proved that he can do the same if the ship be plated. No ship of ordinary size was big enough to carry indestructible plates. Why could not a good fighting ship be made which should keep out a shell? He believed that Whit-

* There has been read to the British Association a paper by Mr. C. Atherton, late Engineer of the Royal Dockyard, Woolwich, "On Unsinkable Ships." The author pointed out the importance of having ships made of a material of less specific gravity than water; so that, whatever injury the ship may sustain so as to admit water, they would never sink, and thus both crew and ammunition or treasures might be saved. He considered such a build would be very valuable for small vessels, which could enter where the large armour-plated ships would be stopped. The idea, he thought, was worthy of consideration.

worth's shell would be stopped by double armour-plates, one in front and the other behind it; but a larger one, it was said, would be made which would destroy any thickness of double plates; and he believed it would be done. There was one way of carrying increased thickness—namely, by the increased size of vessel. There was, however, another way without increasing the size—to build the ship up but little beyond the water's edge; cover her below the water-line as far as was necessary to prevent penetration; then diminish the battery on the deck,—and then they would have a vessel somewhat like the *Monitor*, absolutely shot-proof.—*Ibid.*

INITIAL VELOCITIES AND RANGES.

The majority of the public have found it difficult to understand how it is that a rifled gun which can throw a shot four or five miles, has less destructive effect at short range than an old-fashioned piece which cannot throw two miles. But, while actual experiment has left no room for doubting the fact itself, it is one which, after all, admits of a ready explanation upon the established principles of gunnery and projectiles. By a simple contrivance known as the ballistic pendulum, the Initial Velocity of cannon shot may be easily ascertained, the motion imparted to the heavy mass of the pendulum by the impact of the shot fired against it, together with the relative weights of the pendulum and shot, being all the *data* requisite for calculating the velocity of the latter. Thus ascertained, the initial velocity of the heavy Armstrong shot has been found to vary from 1000 feet to 1200 feet per second, while that of the 68-lb. shot, fired with 16 lb. of powder, from a 95-cwt. gun, is something over 2000 feet. Now, the actual forces contained in moving bodies are as the squares of their velocities, and were it possible to provide a vacuum in which to fire the shots in question, the round shot would have nearly four times the force, and therefore nearly four times the range of that fired from the Armstrong gun. But in the open air the round shot, at a high speed, encounters a nearly fourfold greater atmospheric resistance upon every square inch of its disc than the pointed shot, while also the former has, perhaps, double the area of disc opposed to the air. Hence the velocity of the round shot rapidly falls off on leaving the gun, and thus, although having great destructive power at short range, its force is spent after a flight of perhaps one, perhaps two miles.—*Engineer.*

DISCS AS PROJECTILES.

Mr. R. W. Woollcombe has read to the Royal Society a paper, in which he gave an account of experiments which appear to him to show that certain Eccentric Oblate Bodies and Discs, as projectiles in large guns, may effect not only an initial velocity greater than that of spherical shot, but a terminal velocity better sustained than that of rifle projectiles. Details and the results of the experiments at Shoeburyness are given.

IMPROVEMENT IN PROJECTILES.

Mr. Whitworth, of Manchester, has patented a machine for preparing Projectiles, which consists in placing the projectile in a holder or chuck, in which the projectile is held in the middle or intermediate of its length; the machine is arranged so that the chuck may be made to revolve, and that the tools which produce the required shapes to the ends may be moved up to and from the fore and rear parts respectively of the projectile, or the projectile may be held and presented to revolving tools. For details with illustrations, see the *Mechanics' Magazine.*

LONG AND SHORT PROJECTILES.

Since the Ordnance stores have been filled with Long Lead-coated Shot sufficient to last for several years—if they can be made to keep without deterioration from galvanic action—it is said to have been discovered that Short Shot are the proper thing. Lately projectiles weighing from 58 lb. to 68 lb., instead of 110 lb., have been fired from the 110-pounder guns at Shoeburyness, and a velocity of from 1550 to 1600 feet per second obtained by increasing the powder charges. This is, however, still below that of the 68-lb. shell, which has a velocity of 1810 feet per second, while the solid ball from the same gun has a velocity of 1580 feet per second, with the very large windage of two-tenths of an inch—but will the fine grooving stand the strain due to the increased velocity given to the short projectile?—*Army and Navy Gazette.*

IRON FORTS.

Mr. Hawkshaw, in his inaugural Address, as President of the Institution of Civil Engineers, has remarked:—

In a very few years, mainly in consequence of the labours of Sir William Armstrong and of Mr. Whitworth, the range of artillery has been doubled. The weight of the gun in proportion to that of the projectile has been reduced to one-half, and the capacity for powder of the elongated as compared with the round shell has been more than doubled. This great advance in the destructive power of cannon has rendered most of our old fortifications useless. New Fortifications have therefore to be built, adapted to the longer range and greater destructive power of the new artillery. These fortifications require to be placed more in advance of the places to be defended, and to be constructed with very superior powers of resistance to those which hitherto have proved sufficient. The old walled towns, which were formidable enough in former days, would to-day, in case of a siege, afford little security to the inhabitants who dwell within them; the old defences, therefore, have to be removed, and replaced, where necessary, with those more suitable to modern requirements.

We are clothing our ships of war in iron mail, and it seems probable that iron in some cases will be largely used in modern

fortifications. Not that earthwork and stonework will cease to be useful. These are valuable for the staple of most forts, but neither of them make good embrasures, and for that purpose iron offers great advantages. By its use greater strength can be secured at those points where power of resistance is specially wanted. By its use also the size, and consequently the exposure, of the embrasures will be diminished, and much greater facility be given for working the guns and training them through larger angles.

There are some cases, however, in which forts may with advantage be principally, if not wholly, built of iron. There can be no insuperable difficulty in constructing iron forts so as to be impregnable to a ship's battery, though in the absence of knowledge as to what may be the ultimate power of guns, it is not easy at present to arrive at safe conclusions. The difficulty of doing the converse of this, viz., of building ships so as to be impregnable to the fire of such artillery as may and ought to be placed in the new forts will be a problem not so easily solved.

No plated ship yet built could keep afloat under the fire of guns throwing shots of 200 to 300 lbs. weight; and it seems difficult, in the case of ships which require buoyancy, sufficiently to increase the thickness of their armour-plates to keep pace with the probable advance in weight and size of the new cannon.

THE SHOEBURYNESS EXPERIMENTS.

(WE quote the following comprehensive account from the *Saturday Review*, October 4—the most recent summary of these important results.)

The long duel between armour and guns goes on with alternations of success, and absence of any decisive result. In this experimental competition it is easy to be impartial, for one scarcely knows whether, in the interests of England, the triumph of ships or of guns is the more to be desired. The last trials have given, for the moment, a decided advantage to the artillerists, and have completely displaced the conclusions drawn from the exploits of the *Merrimac* and the *Arkansas*, and revived after the bursting of the monster Armstrong gun, which alone had succeeded in penetrating the Warrior target. A month ago, the ascertained results of the Shoeburyness Experiments might have been summed up by saying that armour-plates of first-rate quality were proof against everything except the heaviest known ordnance at point-blank range, and were absolutely invulnerable to the most formidable of all missiles—a live shell. All this is changed by more recent experience. A "Warrior target," not indeed equal in quality to the sides of the frigate herself, but still tough enough to escape actual penetration by a smooth-bore 68 at 200 yards, has been pierced, at the short range, by a shot from the enormous Horsfall gun, and utterly smashed by a Whitworth projectile at 600 yards. More than this, it has yielded to shells from guns of small calibre

at 200, and from the large Armstrong-Whitworth at the same range of 600 yards at which the solid shot had succeeded in piercing the target. At the same time, it was found that the Horsfall gun (the largest smooth-bore in existence) was, at 800 yards, very defective in aim, though capable of doing almost as much damage, when it did hit, as its rifled competitor. The only approach that can be made towards forecasting the future is, to ascertain rigorously how far the scientific principles supposed to be established by earlier trials have been confirmed or varied by the most recent experiments.

The summary which Sir William Armstrong gave some months since of the conclusions to be drawn alike from theory and experience was certainly justified at the time, and is not substantially invalidated by the startling results which have since been achieved. The rough rules were these—that rifled and smooth-bore guns were as nearly as possible equal in effect at short ranges, if the same charge of powder were used—that as the distance increased, the advantage of the rifled gun became greater and greater—and that the penetrating effect in every case varied almost directly as the charge of powder, and was tolerably independent of the weight of the projectile. The last trials have given greater prominence to another fact which was also well known before—that a great increase of penetrating power may be obtained by using flat-headed projectiles of hardened metal; but this does not constitute their whole significance. It is, in a scientific sense, satisfactory to find that none of the previous conclusions need to be substantially varied. The comparison between rifled and smooth-bore guns stands nearly as it did before, subject to some correction when flat-headed bolts are used. The 150-lb. Armstrong, used as a smooth-bore with a charge of 50 lbs. of powder, had just managed to make a hole in the Warrior target. The Horsfall smooth-bore, throwing a shot of 275 lbs. with a charge of 75 lbs. of powder, did—as it ought to have done—something more. It smashed the target at 200 yards, and did almost as much mischief (when it hit) at 800 yards, though it was not quite able to get through all the successive layers of the target. The difference corresponded as nearly as might be to the increase in the charge, and strikingly confirmed the inference drawn from the long series of experiments which had been made with Armstrongs and sixty-eights.

The practice with the Whitworth guns, though it has thrown further light on the comparative merits of rival methods of rifling, has not displaced any part of the theory which was previously considered to be established. It has proved two things—first, that a given charge of powder will produce more effect with a hardened flat-headed bolt driven from a Whitworth gun than it will with any other known projectile, whether a round shot from a smooth-bore, or a conoidal projectile from an Armstrong gun. Secondly, that a shell may be so attached to a solid projectile—or, more strictly speaking, made part of it—as to enable it to pene-

trate with almost the same facility as a solid shot. This last result had been long foreseen and predicted, though never before practically arrived at. The superiority of flat-headed shot had also been demonstrated, though the full importance of the form had not perhaps been rightly appreciated. The facts on which this last-mentioned advantage of the Whitworth principle rests are startling enough, and will probably introduce a great modification into the system on which our artillery is constructed. In the first place, a mere plaything gun, a twelve-pounder, scarcely larger than an ordinary field-piece, sent a shell through an iron plate supposed to be absolutely bomb-proof. This, it is true, was done at short range, against a target very much slighter than the side of a modern frigate, but the fact was sufficient to disturb the serenity of naval captains, who thought that enough had at any rate been done to satisfy their fervent aspiration—"For God's sake keep out the shells." The second experiment was still more astonishing. This time the weapon was of considerable calibre. It threw a shot or shell of 74 lbs., and at 200 yards it made easy work of $4\frac{1}{2}$ inches of iron, with the customary allowance of teak backing behind it. A shell-proof ship, according to present modes of construction, became at once an unattainable luxury—that is, supposing an enemy to come to close quarters. The third and last experiment removed even this qualification. The range was 600 yards; the weapon was a piece of more than 7 tons, built upon the Armstrong plan, but rifled in the form adopted by Mr. Whitworth, and used with one of his favourite flat-headed shells. The horrible missile went clean through everything, smashing a hole that no ingenuity could stop, and scattering its fragments freely in the rear of the target, or what would be, in practice, the fighting deck of the ship. The shell-proof range for the *Warrior* must, therefore, now be extended to something more than 600 yards; and if all vessels had to encounter the most formidable kind of artillery, the art of making them even approximately safe must be declared to be still a desideratum. Scientifically, there is nothing surprising in the fact that a Whitworth shell can penetrate wherever a solid shot of equal weight can make its way. The projectile used at these trials was nothing but a solid shot of about 130 lbs. weight, with three or four pounds of powder in a chamber at the rear of it. The old-fashioned shell failed to penetrate because it was too slight in construction to bear the concussion without instantly breaking to pieces. A flat-headed bolt, solid for nine-tenths of its length, has no such difficulty in forcing its way through anything that opposes it, and it might have been expected to do what it actually has done—practically to annihilate all distinction between shot-proof and shell-proof plating.

A much more striking feature of the experiment was the comparative smallness of the charge which sufficed to penetrate the target. The only complete triumphs of other weapons were obtained in the case of the Armstrong, with 50 lbs. of powder, and of the Horsfall gun, with more than 70; and it had come to

be almost a settled maxim that nothing less than 40 or 50 lbs. of powder could be relied on to send a shot from any kind of gun through a Warrior target. The Whitworth bolt did its work with a charge of no more than 25 lbs., and this at a range of 600 yards, which had scarcely been attempted before. It is true that the plate was not quite up to the mark of the armour of the Thames Iron Company; but it stood the test of a 68-lb. shot at 200 yards (we presume with the ordinary service charge), without being actually penetrated or smashed to pieces. On former occasions a charge very nearly approaching 25 lbs. has failed to do more than dint a 4½-inch plate at the shortest ranges; and for the present it may be assumed that the flat-headed Whitworth bolt, fired, as it must be, from a rifled gun, will get much more penetrating power out of a given quantity of powder than any other known form of projectile. The importance of this fact, if it should be confirmed, as it probably will be, cannot be exaggerated. The limit to the power of artillery is given by the weight of the charge. There is only one gun which can be fired with 70 lbs. of powder. It is doubtful whether there are any others which can be called safe with 50 lbs., and it is certain that none of the service guns are calculated for a charge of more than half this weight. By making 25 lbs. of powder do the work of 50 lbs., Mr. Whitworth has removed the ultimate limit of artillery power to double its former range; for all the serious difficulties, whether in the original construction or in the actual use of artillery, resolve themselves into the one problem of making a cannon heavy enough, or rather strong enough, to bear the explosion of a given amount of powder.

The use of the effective flat-headed shot, either in the solid form or as shells, as may be desired, necessarily implies the use of a gun rifled without the chamber which is part of the Armstrong breech-loader, and the success of the first official trial of the new shell may be expected to lead to the general introduction of a new class of heavy ordnance. For light field-pieces, the Armstrong principle, and especially the Armstrong shell, are at present unsurpassed for destructive power. But there are many practical difficulties in the use of breech-loaders as heavy guns, which leave the superiority at present with the muzzle-loading principle; and it is now tolerably clear that the Armstrong plan of a loading chamber, fitted to receive a shot somewhat larger than the bore of the piece, will be superseded by mechanically-fitted bolts, which may be made of any dimensions that may be required. It would be interesting to know how much of the success of the Whitworth shell is due to its flat front, and how much is to be attributed to superior velocity at the cannon's mouth, obtained by his system of rifling. Probably it would be found, in the case of ordnance as in that of rifles, that the velocity of projection is nearly the same whatever principle of rifling is adopted, and that the real superiority of the hexagonal bore consists in its convenient adaptability to any kind of shot, whether solid or charged

with powder, which it may be desired to use. It is only fair to state that the late triumph is shared between Mr. Whitworth and Sir William Armstrong. The rifling and the projectile were suggested by the former, while the gun itself was built on the coil principle, which has given such satisfactory results at Woolwich. The combination seems to have produced the most perfect piece of ordnance in existence, and it may be hoped that no personal or official considerations will prevent its general adoption, if future trials should confirm the conclusions which have been so remarkably established.

WHITWORTH AND ARMSTRONG FIELD-GUNS.

In October last some important trials of rifled field-guns took place at Fort Twiss, near Shorncliffe, in the presence of General Bloomfield, Inspector-General of Artillery, and a large staff of officers. For the first time an open comparison was made between the Whitworth and Armstrong Field-guns. Four of the former and two of the latter were fired side by side. The Whitworths formed part of a battery of brass muzzle-loading 12-pounders —the first rifled on Mr. Whitworth's system that have been placed in actual service. The Armstrongs were breech-loading iron 12-pounders. The brass muzzle-loading gun, which is never out of order, never disabled in the breech, and little liable to injury from accident or weather, has much to recommend it. France has always preferred these guns; they are worked as easily as the old smooth-bores, while, with Mr. Whitworth's system of rifling, they are (as appears from the late Shorncliffe trials) superior in precision and rapidity of fire to the breech-loading Armstrongs of the service.

The trials at Fort Twiss began by firing at a floating target, distant 500 yards; as the shot fell in the sea, no very accurate comparison could be made as to the respective hits; but, both at the 500 yards range and at the 1200 yards range, at which the guns were afterwards fired, the Whitworth was the first to shoot away the flag aimed at. On the whole, the shooting of the Whitworth at both ranges was evidently closer than that of its rival. Both guns were tried with shell: the Armstrongs fired the compound percussion shells, many of which burst high in the air, and of course ineffectively. The Whitworths fired a new kind of shrapnel, under the superintendence of Colonel Boxer, who has, by permission of the War-office, rendered Mr. Whitworth most valuable assistance in perfecting this new projectile. It is ignited in front, like the old shell, by means of the simple Boxer time-fuse, and all the complication of percussion apparatus is dispensed with; at the required moment the bursting charge blows off the front of the shell, scattering from 40 to 50 bullets of lead and segments of iron, all of a size large enough to be effective. The iron case of this shrapnel, when fired at long ranges, is not broken up, but weighing 7 lb. or 8 lb., it acts as a solid shot, and remains effective after it has delivered its contents in a diverging shower. So that, while the bullets and segments would take effect upon a group of artillerymen, the heavy hollow case would smash a gun carriage, or otherwise disable a gun. If required for short ranges the iron can be burst into fragments by increasing the bursting charge.

The practice with these terribly efficient projectiles was, on the whole, excellent; very few burst short. Perhaps the most interesting part of the trials was a comparison made between the Whitworth and Armstrong guns with regard to rapidity of fire, in which the advantage was on the side of the Whitworth. Twenty rounds were fired from each gun as rapidly as they

could be served. The first gun that completed its twenty rounds was a Whitworth, which finished in 13 minutes; the second, an Armstrong, which finished in 15½ minutes, the Whitworth proving the victor by 2½ minutes. This result was owing to the simplicity of the method of loading and serving the muzzle-loading Whitworth—the drill, in fact, being that of the old smooth-bore. All the guns were further tried by firing from each a hundred consecutive rounds. The Armstrongs were fired with lubricating wads, and were washed out, and changed their breech-pieces as often as they became disabled by being overheated. The Whitworths all completed their 100 rounds without being washed out at all, and without using any lubricating wads. The loading of the guns was as easy at the last round as at the first. This practical proof of the efficiency of the brass muzzle-loading guns will be very gratifying to those who prefer their simplicity to the complication of the breech-loader. In point of economy the use of the brass guns is advantageous both as regards first cost of manufacture and non-liability to injury from exposure to weather.

The real secret of making the Armstrong gun (says the *Mechanics' Magazine*) may be told in two or three words. It consists of winding bars of red-hot iron into a spiral coil, welding them together in one massive tube, boring them out, and then shrinking one over the other till the requisite strength and thickness are attained. It is then a mere rifled tube with trunnions. A hole is cut for the breech or vent-piece to drop in, and a lever screw put at the back to close it up, and then all is finished. But for the manufacture of each of these component parts the most exquisite skill and the most wonderful mechanical tools are requisite. The tubes are forged together as clean as castings, and the vent-pieces are gauged with Whitworth's gauges to the 1-1000th of an inch. The 1-1000th of an inch has been till now an imaginary standard, but in the Royal Gun Factory at Woolwich it is an actual fact that this perfection of fitting is attained.

The 300-pounder Armstrong gun has been proved at Shoeburyness as a smooth-bore. The proof consisted of four rounds—the first with 60 lb. of powder, the second with 70 lb., the third with 80 lb., and the fourth with 90 lb. After the proof, further experiments were carried on with the same gun, to ascertain the initial velocities obtained with large charges of different kinds of powder.

THE HORSFALL GUN.

THE Iron Plate Committee having concluded their experiments with the Horsfall Gun, this powerful piece will be removed to Liverpool, the Mersey Company purposing to obliterate the damage sustained by the bore while lying so long on Portsmouth beach. With this and some other improvements, it is confidently anticipated that the gun, when properly "sighted," will shoot as accurately as a rifle up to 2000 yards, and may yet realize the intentions of the donors in being "used against the enemy" from a shield ship. In the early trials at Shoeburyness the Horsfall made eight consecutive shots at 600 yards, fitted with the common brass sights, which only varied 18 inches from the mean line; but in later practice against the Warrior target merely a temporary wooden tangent was used.—*Army and Navy Gazette.*

The Mersey Company state, with regard to the practical information obtained by the late experiments, besides the fact of this now old-fashioned gun being the first that ever thoroughly and effectually pierced the Warrior target, the point of greatest importance is that this gun, having been forged solid, presents a marked contrast to other wrought-iron guns of later make, which are built up; and the comparison is quite in favour of the solid gun, both in its resistance to the explosive force of powder and its endurance of the cold neglect of months of exposure on a wild seashore, with every tide washing into and over it. After having between 7000 lb. and 8000 lb. of powder, and upwards of 60,000 lb. of shot blown out of it, the bore is perfectly uninjured, the searchers from Woolwich not being able to detect any alteration; and the action of months of rust by the sea-water only enlarged the bore 100th part of an inch.

The gun is to be returned to these works to have the original flaws, not in the bore, but at the end of it, cut out and replaced by a screw, when there is no doubt that the gun will be as perfect as new, and will still remain, as was officially reported seven years ago, quite fit for Her Majesty's service, and when new and modern sights are placed upon it, in place of the damaged and imperfect ones, there can be no doubt that its practice will be as much more exact than any other smooth-bore gun, as its bore is greater.

In conclusion, although the Horsfall is the largest wrought iron gun made, yet, if larger are required, it is believed that modern machinery will as easily make guns of more than double the size, and to propel shot at as high an initial velocity as that lately obtained with the 13-inch gun.

MR. SCOTT RUSSELL'S TARGET EXPERIMENTS.

THE Experiments at Shoeburyness against Mr. Scott Russell's Target will lead to conflicting opinions and statements respecting the comparative merits of steel, cast-iron, and wrought-iron shot. If expense were no object, the penetrating power of steel shot would recommend it. Wrought iron, in some respects, is superior to cast-iron, but the latter has prodigious powers of destruction, owing to its splintering properties if it makes an entrance. Sir William Armstrong's 150-lb. smooth-bore was fired with a wrought-iron shot and a charge of 50 lb. of powder at the usual distance of 200 yards against the target, and hit it in the strongest part. The weight and thickness of Mr. Scott Russell's target are greater than the *Warrior's*; but, although the tremendous projectile bounded back flattened from the iron side, it made a hole right through, and drove a flight of iron fragments into the wood-casing at the back of the target. If one shot did this, what would half-a-dozen do? We have got nearly to the length of our tether in regard to the thickness of plating, but it is becoming tolerably clear that at short ranges the modern artillery, if it has time enough to do its work, will demolish the iron ships;

and when we get rifled guns of similar large calibres to the smooth Armstrongs, we shall be able to increase the range of our destructiveness. Is it not astonishing that the public should be told that the 150 lb. Armstrong had been ruptured and ruined, when we find it actually in full blast with 50 lb. of powder at Shoeburyness?—*Army and Navy Gazette.*

NEW GUNPOWDER.

A NEW Gunpowder was tried at the late Frankfort shooting-feast, apparently with success. Its merits are, a lower price, a less weight, a more effectual action, than the general powder, to which a more important merit is added—that after thirty shots it left the barrel as clean as it was before firing. Its colour is yellowish brown; it is granular, and looks like decayed wood ground small. The inventor is a Prussian artillery captain in Spandau; and his invention is being tested by the Prussian Government.

GUNPOWDER SUPERSEDED.

HAUPTMANN SCHMIDT, a captain of artillery at Berlin, is the originator of this discovery, whose idea was subsequently imitated and improved by Colonel von Uchatius. The latest explosive material consists of the flour of starch, which, boiled in a peculiar way with nitric acid, possesses a far greater projective force than the gunpowder in ordinary use. It has also the great advantage of not fouling the piece to any appreciable extent, and, from the nature of the materials used, is produced at a far cheaper rate. Another point in its composition which recommends it especially for fortresses and magazines is the facility with which the ingredients are mixed together, thus rendering it possible to keep them separate until wanted for actual use. In this state the powder is non-explosive. The experiments now in course of progress in Vienna and Berlin are said to leave little doubt as to its general adoption in the Austrian and Prussian armies.

A NEW SYSTEM OF ARTILLERY.

GENERAL VANDENBURGH, of New York, who has been engaged for some time in this country with experiments in gunnery, has made public the results in a lecture before the Royal United Service Institution.

This result is a New System of Artillery, by which a group or cluster of shot are projected, with the highest attainable range and precision to each, the group being such as to sweep and cover the largest area of space with the destroying force.

He exhibited the parts of two guns, one projecting 91 2-oz. shot, the other 85 of the regulation weight of 530 grains each.

The guns are similar in form, of no greater weight, and discharged in the same manner, and with the same facility and rapidity as any single shotted breech-loading gun projecting the same weight of metal.

One is a 12-pounder and one a 6-pounder; each is composed of a cluster of tubes or gun-barrels, corresponding to the number of shot.

It was demonstrated that less weight of metal was required in one or two hundred tubes, or bores, for projecting a given weight of matter, when sub-

divided into so many small shot, than in one tube or bore, for projecting this matter in one shot. He also referred to experiments, showing that each of these small shot can attain as great accuracy at long range as the larger mass.

The union of these tubes, in a hollow cylinder, or outer case, so as to assume the same general form as ordinary artillery, without impairing the independent capacity of each to do its duty, was also explained.

One hundred and sixty-three of the Enfield gauge tubes, for projecting 2-oz. solid shot or shell each, making a 20-pounder gun, are less than one foot in diameter; while 365 of the "small bore" make a gun of no greater dimensions. The breech is extremely simple, each tube or bore has its separate charge-chamber, the whole in one block or piecer. A powder-charger (a small brass case) instantly drops a measured charge of powder into each at the same instant, and a cluster of shot corresponding to these chambers are placed in them with the same ease and facility as if there was but one shot. The ignition is from a common centre, from which the fire is radiated to all the chambers. The group of shot diverge slightly on leaving the muzzle. If the barrels are arranged parallel to each other the mechanical defects give a good cluster for extreme range, and will disperse the shot something over 100 feet at a mile. If greater divergence is required, the muzzles are slightly separated or set divergent.—*Mechanics' Magazine.*

AUSTRIAN GUNNERY EXPERIMENTS.

THE Austrians have been steadily pursuing a systematic course of Experiments with Gun-cotton, and not only have they perfected this material so as to use it in field-guns, but have also been led to investigate the properties of metals, with the view of finding an alloy which would impart hardness to copper, and enable them to obtain a perfect, safe, strong, and durable gun. This they have now effected, and it is said that their gun-metal, by the addition of a small quantity of iron, has been made very hard, and also exceedingly tough and elastic. One great advantage possessed by this gun-metal is, that it can be recast at small cost if the guns become damaged, or the rifling prove unsatisfactory. The field-pieces have been rifled with groves, which help to support the projectile in centring upon a rounded bearing. The projectile is of iron only, indeed nothing else would withstand the force of the gun-cotton, which is more instantaneous in its explosion than gunpowder, and therefore a higher velocity can be obtained with a much shorter gun. The Austrian Government is now about to cast large ordnance, and if the reports given to us be correct, they have certainly hit upon the right metal, as it withstands the blows of shot fired at it much better than any material which we have yet used in England.—*Army and Navy Gazette.*

IRON-CLAD NAVIES.

MR. DONALD M'KAY, the American shipbuilder, has furnished to the *Boston Commercial Bulletin* an interesting account of the Iron-clad Vessels of England and France. France has 10 iron-cased floating batteries, 4 large iron frigates, and 2 rams, and has on the stocks 10 iron frigates and 4 batteries, which can be completed in one year, if necessary. The English have 6 iron frigates, but are building 7 iron ships, and are casing 5 or 6 ships with iron. Mr. M'Kay thinks these French and English ships altogether superior to the American Monitors, which he says cannot live in a

heavy seaway, and a heavy frigate would run them down. Mr. M'Kay says :—

"If we compare with these immense fleets the iron-cased navy of the United States impartially, we have to acknowledge that in case of a war with either of the above Powers we should have to keep entirely on the defensive, to submit to a disgraceful blockade, and to leave our merchant ships all over the globe to the mercy of our enemy. All the Monitors which we are building by the dozen are very well to defend our harbours, but they are entirely unfit to break a blockade or to act on the high seas; for to say that these vessels are good sea-boats, or suitable for men to live in, is simply ridiculous, in which statement I shall be upheld by all experienced sailors and shipbuilders of any note. With their very light draught of water these Monitors never can obtain a high degree of speed, and if ever they should fall in with any of the large frigates in deep water they will be terribly handled, and in all probability run down. Do not think that this could not be done because the *Merrimac* failed in her attempt to run down the *Monitor*. She struck with a speed of three or four knots, or even not as much as that, but a mass of 6000 to 9000 tons in weight driven at a speed of 12 to 14 knots would give a different result. Of all the iron-cased ships that we have, the only one that might successfully cope with the large English frigates, is the *Ironsides*, built in Philadelphia. She is well planned, and her practical construction very well executed, but her speed is too low to use the good points of the vessel to advantage, and the way of fastening her plates will not stand the test of a heavy cannonade; for in the experiments made in England with armour-plates, similarly fastened by screw bolts screwed in from the inside, the bolts broke off short on the inside of the plate whenever a heavy shot struck the plate near such bolts. It is satisfactory to know that Mr. Webb has got a contract for building an iron-cased ship according to his own plans. He certainly will produce something able to compete with any European frigate."

In conclusion, Mr. M'Kay suggests the construction for the Northern navy of 20 to 30 fast iron-cased shell-proof corvettes, of about 10 to 12 heavy guns each, and of a moderate draught of water, with high speed; and about 20 to 30 50-gun frigates, not cased, for foreign service, and as many sloops of 14 to 24 guns, of the highest speed obtainable, so that they may be enabled to strike unexpected blows and to evade their iron-cased adversaries, which never will obtain the same high speed at sea as can be given to them.

Mr. Hawkshaw, President of the Institution of Civil Engineers, in his inaugural Address, remarks : The precise and best mode of constructing ships of war is still an interesting problem. Hitherto a large amount of wood has been combined with the iron. The *Warrior* has a thick lining of timber between the inner skin and the outer armour-plates. A material so soft as wood can hardly increase the capability to resist shot ; and there seems great difficulty in combining, to any good purpose, two materials differing so much in strength and density. Besides which, wood rots, and is, in ships especially, a perishable material. The probability is that iron will supersede the use of wood in a still greater degree, and that, by the adoption of improved modes of construction, the whole of the iron used in the structure of ships of war will be made to add to the strength of the ship, as well as be useful for its defence. This is not the case in the present mode of construction. The armour-plates of the *Warrior* add very little to the strength of that ship. There seems to be no good reason why the upper and lower decks, and every portion of the hull of such vessels,

should not be of iron. Greater strength would be thereby attained to resist diagonal and cross strains, and much greater longitudinal stiffness would be secured. Ships of war should be constructed practically, as far as it is possible, as if welded out of one piece of iron; and if they are ever to be used as rams, this mode must be adopted, for it is evident that the present methods of construction would be quite unsuited for such a purpose.

NEW SCREW RAM.

A NEW YORK paper states that the *Dunderberg* is being built 378 feet long, 68 broad, 32 deep, with engines of 6000-horse power. The hull is built of wood, placed together so as to form a solid mass. The decks, sides, and floor are also solid, and of a great thickness, so much so, that if the figures were given, all would be greatly surprised at the amount of wood used in the construction. This enormous wooden hull is heavily plated with rolled-iron plates, which cover the entire upper portion of the vessel, and extend six feet below the water-line. The weight of this terrible armour is not far from 1200 tons. The bow of the vessel, for 50 feet abaft the stem, is of solid wood, with no space between the sides of the vessel, this being covered with iron, forming the most gigantic Ram on record, having powers of resistance unequalled in every respect. The sides of this vessel above the water-line are seven feet thick and of solid wood, added to which is the heavy iron-plating. This vessel has two rudders, one at each end, so protected, that should one become disabled from any cause, the other can be easily used. The engines will give this vessel a very high speed, so that when she strikes a vessel she would crash through her with perfect ease. Above the main deck the build is very peculiar, but at present cannot be described. In addition to a large casemate, containing heavy broadside guns, there will be two of Ericsson's revolving turrets, each containing two fifteen-inch guns. The naval register puts her armament down at 10 guns, but it will be much larger. The accommodation for the officers and men are to be of a superior kind—large, airy, and as well ventilated as an ordinary ocean steamer, yet giving to them all the necessary security in time of action. In every respect she will be one of the wonders of the age. She is intended more particularly for harbour defences, but can readily go to sea, as she possesses all the qualifications for buoyancy, &c. She will be a most terrible affair, and will defy anything else in the shape of an iron-clad.—*Times.*

CUPOLA SHIPS.

IN a long letter to the *Times*, Captain Cowper P. Coles, of the Royal Navy, shows his claim to be regarded as the true inventor of the form of Iron Ship which is exciting so much attention, both in America and in this country. Captain Coles sends to the *Times* drawings of the *Monitor*, and of a vessel proposed by him to the Admiralty in 1855; and says:—"It will be seen that my

first vessel, proposed as above stated in 1855, was on the same principle as the *Monitor;* having a double bottom; light draught of water, with a power of giving an increased immersion when under fire; sharp at both ends; a formidable prow; her *rudder* and screw protected (a most important point) by a projection of iron; the only difference being that the tower is hemispherical instead of cylindrical, and was not on a turn-table; she being designed for the purpose of attacking stationary forts in the Baltic and Black Sea; when a part would have admitted of sufficient training from the vessel itself turning with great rapidity, and so that the expense and complication of the turn-table became unnecessary. (See report sent from Black Sea, 1855, and the *Times,* November 20, 1855.) A rough model, made by the carpenter of the *Stromboli,* is to be seen in the United Service Institution." It would, therefore, appear that Captain Ericsson, having been so unsuccessful with all his own peculiar inventions as he has been, now seeks celebrity by appropriating the inventions of others.

Captain Coles exhibited models of these ships in the International Exhibition; admitting (he says) of from 7 to 8 degrees depression. In two this is obtained by the deck on each side of the cupola sloping at the necessary angle to admit of the required depression; in the other two it is obtained by the centre of the deck on which the cupola is surmounted being risen sufficiently to enable the shot, when the gun is depressed, to pass clear of the outer edge of the deek. The drawing, published in 1860, of the midship section from which these models were made, also gives a section of the *Warrior* (Figure 5), by which it will be seen that, supposing the guns of each to be 10 feet out of water, and to have the usual depression of guns in the Navy (7 degrees), that the *Warrior's* guns on the broadside will throw the shot 19 feet further from her side than the shield ship with her guns placed in the centre, that being the distance of the latter from the edge of the ship, and thus, with the same depression, the shield ship will have a greater advantage, which I consider to be an important merit of my invention. The *Royal Sovereign's* former deck was flat, but now when completed, it will be constructed with a slope similar to those shown in models, when she will have the advantage of depressing her guns, so as to hit the water at a less distance from her side than most ships in the Navy. Captain Coles is now carrying out his invention under the direction of the Admiralty. The armament of the *Royal Sovereign* has been fixed upon to consist of eight guns, protected by cupolas. The two centre ones are to be of the heaviest now known, and the remaining six to be of Sir William Armstrong's or Mr. Whitworth's 110-pounders. The *Royal Sovereign* is in a state to enable the dockyard people to strengthen her in such a manner as would enable her to carry even a Horsfall gun weighing 24 tons.

FUEL FOR IRON-PLATED SHIPS.

MR. E. A. ALLEN has read to the British Association a paper

"On the Importance of Economizing Fuel in Iron-plated Ships of War," and described a new double expansive marine engine, constructed according to his patent by Messrs. J. and G. Rennie, exhibiting photographs of the same, taken at their works. The author pointed out in detail the principles of marine engine construction, which experience had shown to be absolutely essential in order to economize the fuel—viz., full expansion of the steam, surface condensation, superheating the steam, heating the feed water, jacketing the cylinders, and proportionately increasing the boiler power; and contended that in the ordinary marine engines now fitted to the iron-plated ships, though by the best makers, and of the most admirable workmanship, economy of fuel was impossible. The necessity of largely increasing the cylinder capacity to admit of expansive working, rendered an entire change in the forms of marine engines imperative; the large diameter short-stroke engines of the present day consuming as much as 4½ lb. of coal per indicated horse-power per hour, whereas double expansive engines, on the plan suggested, and every way suited for Government vessels, would save 50 per cent. of the present consumption of fuel. The amount yearly voted for coals for the Navy now exceeds 300,000*l.* per annum, and the author stated it as highly probable that it would rise to upwards of a million sterling when our iron-cased fleet was complete, unless changes were made in the construction of engines employed in war steamers. The engines referred to had been frequently submitted to our Admiralty, and the author hoped there were prospects of his plans being tried; Messrs. Rennie being prepared to guarantee their efficiency and economy. He concluded by referring to the engines proposed by him in 1855, and similar in principle to those made by Messrs. Rennie, but worked by means of a trunk instead of double piston rods, the former plan being, he believed, adopted for the engines of the *Poonah*, now constructing for the Peninsular and Oriental Company by Messrs. Humphreys and Tennant.

Mr. Scott Russell said they were all agreed that the short-stroke engine was wasteful of fuel in marine engines, and of the powers to gain speed. The importance of saving fuel to the Admiralty was so great that they ought to take the lead in experiments for this purpose. Without saying that Mr. Allen's invention was the best that could be devised, he would say that the combination he suggested offered considerable hopes that an economy of fuel would be attained without reducing the work performed by the engines.

WHAT IS IRON?

THIS is a question that has recently been asked in the *Times*, which gives an excellent summary of the principal phases of this extraordinary metal, while at the same time admitting that the question is one which at present cannot be fully answered.

Pure Iron, the writer remarks, is almost unknown. What we

call iron is the metal combined or associated with other elements, which, though present only in small quantity, may, according to their number and proportion, communicate to it widely different properties. These elements are chiefly carbon, silicon, sulphur, and phosphorus; but the most important is carbon. It is a simple variation in the proportion of carbon, within the limit of about 5 per cent., which causes the metal to appear in the three well-known states of wrought-iron, steel, and cast-iron. As the proportion of carbon increases, the metal passes insensibly through these successive stages. It has recently been urged that another element, nitrogen, is an essential constituent of steel; but this theory has been hotly disputed. Sulphur is the most frequent cause of *red-shortness*, and phosphorus of *cold-shortness*, in wrought-iron. One part in a thousand of any one of these elements will produce a decided effect on the quality of the iron, either separately or combined; hence the endless diversity in quality of the iron, steel, and pig-iron, which we meet with in commerce. Then, again, in the case of wrought-iron and steel, the quality of the metal may be greatly modified by the mechanical treatment which it has received; and in the case of pig-iron, by the conditions under which solidification after fusion has occurred. It is a remarkable fact that, so far as our knowledge extends, iron is the only metal which is capable of acquiring such varied and useful properties by the operation of such simple and apparently trivial causes as those which we have just considered. One metal is thus made to act the part of several. The defective state of our knowledge of the chemistry of iron is the opprobrium of modern chemists. There is no metal of which the *science*, properly so called, is less understood.

CHANGES IN IRON.

At a meeting of the Manchester Literary and Philosophical Society, Mr. Dyer has exhibited a broken screw bolt, 1⅛ inch square (used to fasten a cart-body to the axle). The fracture, near the head end, appeared very much like one of cast-iron: imbedded in the centre of the bar was a smooth egg-shaped mass about ½ inch diameter, crossing the fracture, and leaving a cavity as its mould in the metal on one side. He assumed that faults like this were probably owing to the rapid processes in use for reducing masses from the puddle into bars of wrought-iron, whilst the metal was only partially converted to the malleable state, as appeared in this sample of bad iron. The iron, in a semi-fluid state, is passed from the furnace through a succession of rollers, without re-heating or faggoting, as was formerly practised, and at once reduced to the sizes required. The improved rolling-mills could not, it seemed, ensure improved qualities of wrought-iron, whilst they afforded temptations to make it far inferior to any that could have been made fifty years ago. Considering the many hazards to which life and property are exposed in travelling by railway and otherwise, from the iron "shuffled

off in haste," and found in use in engineering constructions, it becomes important that previous tests should be employed to ascertain the real nature of the iron, so as to leave no question of its being in a safe condition for the purpose intended, and not like this specimen, and like much now-a-days made by pressing the half-converted puddle into marketable shapes.

In connexion with the subject of the slow changes which iron undergoes, M. Breguet, of Paris, stated that in their furnace for preparing soft iron, he had observed a remarkable case of crystallization of wrought-iron. One of the furnace bars became brittle; and on breaking a portion of it, he found it to contain a large cubical crystal of iron, each of whose sides measured five millimètres in length. This singular specimen is now in the possession of M. Balard.—*Mechanics' Magazine.*

HARDENING IRON AND STEEL.

MR. E. PARTRIDGE, of the Patent Axle Works, Smethwick, has provisionally specified an invention which consists in first heating the Article to be Hardened in a bath of lead or other suitable molten metals, or in a retort, so as to be protected from the direct action of fire. In applying to it, either in the bath or retort, or immediately on its withdrawal therefrom, a composition presently to be described either in powder or liquid, in some cases the article is returned to the bath or retort after such application. In preparing the composition he takes prussiate of potash or other substance containing cyanogen, or possessing like chemical properties, and reduces it to powder. He mixes with it powdered nitre and common salt, and sets fire to the composition. He takes the resulting ashes or substance remaining after the firing, and powders it. The powder liquefies under heat, and he uses it alone or mixed with charcoal (animal or vegetable), or other suitable form of carbon; or he liquefies the powder by dissolving it in liquid ammonia or other suitable solvent, and applies it to the articles to be hardened in a liquid state.—*Builder.*

MANUFACTURE OF STEEL.

AN important discovery has been made by Mr. Anderson, the Assistant-Superintendent of Woolwich Arsenal, of a simple process by which Steel is rendered as tough as wrought-iron without losing its hardness. This change is effected in a few minutes, by heating the metal and plunging it in oil, after which the steel can be bent, but scarcely broken. The value of this discovery will be at once appreciated by those who are aware of the difficulties hitherto experienced in obtaining a suitable material for the interior tubes of built-up guns. The steel vent-pieces, which cost several thousands of pounds, and were virtually condemned, can now be brought into use; and while congratulating Mr. Anderson on his valuable discovery, which is, in fact, merely the result of careful experiment, we may express a hope that the services of this very eminent mechanic will receive

an appropriate reward. We cannot forbear mentioning that the bullet-making machine alone would be sufficient to stamp the reputation of Mr. Anderson as being one of our ablest mechanical engineers, and to show that the right man has been, for once at least, put in the right place.—*Army and Navy Gazette.*

BESSEMER STEEL.

At a meeting of the Manchester Literary and Philosophical Society, Mr. Brockbank has exhibited some samples of steel manufactured by Mr. Bessemer's process. These specimens, report the printed Transactions of the Society, had been bent and twisted cold, and showed a remarkable degree of ductility. He stated that the Bessemer Steel was one of the most plastic and manageable of metals,—more so even than copper. It could be bent, flanged, or twisted, either hot or cold, without annealing, and over a considerable range of temperature, which is not the case with ordinary steel or copper. A plate of 18 inches diameter had been forced through a series of dies until it formed a tube 13 feet long and $1\frac{3}{4}$ inch diameter, without any crack or flaw. In drilling a circular hole into a plate, continuous shavings are formed; whereas in copper, Low Moor plates, or any other metal, the shavings break into pieces $\frac{1}{16}$ inch long. Thin sheets of Bessemer soft steel can be bent backwards and forwards hundreds of times without a fracture, and are almost as flexible as paper.

At the Franklin Institute, Mr. J. W. Nystrom has exhibited some specimens of iron and steel, manufactured at his establishment, Gloucester, N.J., by Bessemer's process, and made the following observations:—"The cast-iron is smelted in an ordinary cupola, from which it is run into a barrel-shaped furnace, where air is blown into the molten iron for about ten to fifteen minutes,—the time required for decarbonizing it to steel or wrought-iron; after which it is run direct from the steel furnace into moulds of any desired shape. Ingots thus cast can be taken direct to a rolling-mill or steam-hammer, and worked in the one original heat. The steel furnace now in operation is for acting on 3000 lb. cast-iron at a time, which gives about 2500 lb. of wrought-iron or steel. By the process known as Bessemer's the ingots are rolled out to finished iron in the first original heat, and slag is hardly perceptible. A great many parts of machinery which in Europe are made of wrought-iron or steel are in this country made of cast-iron. Now, by this process, such parts can be cast direct of steel or iron, which will materially reduce the weight and increase the durability of the machinery. I consider the process to be of the greatest importance for railroad iron, such as wheels, tires, frog-plates, rails, &c."

STEEL PENS IN FRANCE.

The manufacture of Steel Pens is now extensively carried on in France, though the material used therein is imported almost

exclusively from Sheffield. At one establishment at Boulogne, that of Messrs. Blanzy, Pore, and Co., no less than 45,000 gross of steel pens are turned out weekly, in addition to something like eight tons of crinoline. The manufacture of this latter resembles, to a certain extent, that of steel for steel pens, and hence the combination of the two branches of industry. Messrs. Blanzy and Co. employ in the whole 600 hands, the majority of whom are females. The superintendents of the various branches of this extensive steel manufactory are, however, without exception, Englishmen. There is no doubt that the comparative cheapness of labour in France, as compared with its price in England, contributes to make the French steel pen manufacturer a formidable rival to the English producer of those indispensable articles. Still there seems to be "room enough for all," as the demand for pens hourly increases.

JONES'S PATENT MARKING MACHINE.

THIS new mechanical contrivance for preparing the edges of discs of metal, intended for coin, or what is known among the initiated in money-making as a "marking machine," is in use at the Royal Mint, Tower-hill; and since the introduction of the Patent Marking Machine to the coining department, it has had transferred to it the whole of the work which formerly required the services of eight ordinary machines.

So universal is its application, and so rapid and exact is its action, that we were not surprised to learn that other mints were beginning to appreciate its usefulness, and to adopt it in place of the antiquated machines for the same purpose hitherto used. Two of the machines have just been finished and forwarded to India for the Madras Mint. The machine raises the protecting edges on gold or silver coins at the Mint at the rate of about 700 per minute.

Some idea may be formed of the simplicity and durability of the patent marking machine of Mr. Jones—who, by the way, is a Mint *employé*—when it is further stated that one machine has operated upon the whole of the coinage, gold, silver, and bronze, struck at the Royal Mint during sixteen months, and this without renewals or additions of any kind. Messrs. Watt and Company, of Soho, near Birmingham, who are the contractors for upwards of 1700 tons of the new bronze money, now so largely and satisfactorily in circulation among Her Majesty's subjects, adopted the new marking machine many months since, and report highly, it is said, of its merits.—*Mechanics' Magazine, abridged.*

PREVENTION OF RUST.

MESSRS. T. AND E. MYERS have patented the following composition for Preventing Rust on bright steel, iron, brass, or metal surfaces. The patentees say:—Take, say 10 lb. of gutta-percha, 20 lb. of mutton suet, 30 lb. of beef suet, half a gallon of sweet oil, two gallons of neat's-foot oil, one gallon of oil of thyme, and half a pint of rose-pink, or other suitable perfuming and colouring

matter. These ingredients are gently simmered until the whole is dissolved and well mixed together. When cold, the composition is ready for use.

NEW MINERAL PASTE.

A NEW material has been produced by Mr. J. S. Manton, of Regent-street Works, Birmingham, which is said to be likely to enter largely into the manufacture of many articles in connexion with the Birmingham and Sheffield trades. The new material consists of mineral, earthy, arenaceous, or other such substances, including animal shells of all kinds, as pearl or oyster, glass, pebbles, marble, slate, ballast, or slag. These are powdered and amalgamated into a Paste under a great heat. In this state the material, as a plastic composition, is capable of a very extended application to the fine arts. It can be readily transferred to dies, and will receive the sharpest impression. It may be made of any required colour, and is susceptible of high polish.

NEW GUN-METAL.

A CORRESPONDENT of the *Times* communicates the composition and mode of forming the new alloy which has been proposed in Austria as a substitute for ordinary Gun-metal, consisting of copper and tin. It is composed of 60 parts of copper, from 34 to 44 of spelter, from 2 to 4 of iron, and from 1 to 2 of tin. The iron, which must be wrought-iron, is put at the bottom of a crucible with the copper upon it, and the whole exposed to a very high temperature. The tin is then added, and afterwards the spelter. The metal is stirred, left for a minute or two, stirred again, and afterwards cast. A 12-pounder gun made of this alloy was heavily charged with powder, rammed full of sand, plugged at the muzzle with a piece of iron, and in this state fired. All the gas resulting from the ignition of the powder escaped through the touchhole; and not only was the gun found to be uninjured, but on careful examination not the smallest alteration in its internal diameter could be detected. This indicates extraordinary toughness and elasticity. The preceding information has been personally communicated by the inventor with full permission to disclose it.

IRON STREET PAVING.

THE Poultry has been laid with this new Pavement, which is a modification of Knapp's patent, and consists of heavy cast-iron sections, hollow and hexagonal in form, locking together at their junctions, and presenting numerous small projections over their upper face. These sections are solidly bedded and filled to the surface level with ballast, well rammed, and next to the kerbs the blocks abut against Redman's cast-iron trams. Greatly increased durability, together with sure footing, is expected to be gained by this mode of paving, the granite being found unable to withstand for any length of time the immense traffic passing over this short

length of street. An adjoining portion has been laid with granite paving, in combination with Carey's cast-iron wheel track. In this invention the side towards the centre of the roadway is notched at intervals to admit the ends of the granite sets, the other side abutting upon the iron drawing kerb, and thus is obtained a good track for the near wheels of carriages and a channel for the surface drainage. These works will afford a favourable opportunity for comparing the respective capabilities of iron and granite paving in one of the most crowded streets of the metropolis. The work has been done, under the direction of Mr. William Haywood, the engineer to the Commissioners of Sewers, by Messrs. Crook and Son, and Messrs. Ransome, of Ipswich.

ART IN COPPER.

THE malleable quality of Copper and its adaptability to the purposes of Art have seldom been more fully demonstrated than by Mr. Thomas Phillips, of Snow-hill, in a work of very high merit. His figure of a "golden eagle" is the first attempt made to render feather for feather in either metal or stone. The eagle, which is of the natural size, stands on the summit of a rugged and precipitous rock, in a bold and threatening attitude. The whole figure is instinct with life, and has more the appearance of a real bird electrotyped by some miracle than aught else to which it can be compared. Every one of the minute feathers which cluster round the neck, the fine hair-like down which runs from the beak to the eye, the soft cushion of plumage at the junction of the wings and body, are here separate, and can be each separately raised by the finger. The half hairy, half feathery legs of the bird are wonderful in the fineness of the down which overspreads them. The most extraordinary triumph of Mr. Phillips's skill, however, is shown in the extremely minute feathers which cover the frame of the pinions and which conceal the fastenings of the large feathers forming the tips of the wings. It would be impossible to overrate this portion of the work, so numerous and so thick are the feathers, and so soft and deep is the effect produced. The rock which forms the eagle's eyrie, a fine mass of tin and antimony in combination, is of bold workmanship, and forms a pleasing contrast to the somewhat dusky colour of the plumage. Nothing can be more happy than the colouring of the figure of the bird. The metallic lustre of feathers, so difficult to imitate in painting, is here rendered with great felicity. Equally good also is the horn-like appearance given to the beak and talons, while the yellow and wrinkled scales of the feet are lifelike. The mode of colouring which Mr. Phillips has employed is a secret of his own, and was discovered by him in the course of executing this figure. It is an improvement on the old system, inasmuch as it supersedes the aid of a battery by a new process of what may be called cold electrotyping. Its chief advantage over the ordinary method consists in the variety of colouring on the same surface which it allows, and its superior economy. For six years Mr. Phillips has been employed in bring-

ing this work of art to its present condition. More than 10,000 feathers, formed from ordinary copper-plate, all made by hand, some of which had to pass twenty-six or twenty-seven times under the hammer and graver, were necessary for the plumage alone, and show the unwearied patience and industry employed on what has evidently been a labour of love.—*Times, abridged.*

STEAM-HAMMERS.

MR. FEARNLEY has patented certain improvements in Steam-hammers. The patentee forms the steam cylinder annular, in order that the ram may pass through the inner or central part of such cylinder, and thereby have increased guiding surface in its motion, as also to reduce the height of it: and he forms the piston annular with rods passing through the head of the cylinder to a cross-head affixed to or formed upon the ram, or through the bottom of the cylinder direct to the hammer above the head. He also forms the hammer to surround the cylinder; the piston-rod being keyed into the hammer just above the head. In this case the cylinder is fixed to the upper part of the framing, and the framing below is bored, to receive and guide the hammer in its motion; whilst the inside of the hammer is bored true to slide on the cylinder. He also gives motion to the valves of steam-hammers by means of a spiral groove or feather, cut or formed in the hammer, acting upon a pin or stud in connexion with the valve or valves.

Mr. R. Wilson has also patented improvements, consisting in an improved arrangement of valves and gearing for working steam-hammers, by which the steam may be admitted both below and above the piston to which the hammer block or ram is connected, or only to the former when required. The improvements in valves for steam-hammers and other steam-engines consist in so constructing them, that their area, and, consequently, the weight and power required for working them, are greatly reduced.

MALLEABLE IRON NAILS.

BESIDES the very extensively employed machine-made nails, there is another description of nails getting into use, especially for fixing tiles on to the roofs of factories and similar buildings. These are Nails of cast Malleable Iron. They oxidize much less in damp air than common iron nails, or even copper ones. To manufacture them, very hot metal is run into ordinary sand moulds. These malleable iron nails are very brittle before being placed in the annealing furnace. Their sojourn in the furnace renders them very ductile. They are then put into polishing barrels, in which they are cleaned, whereupon they are thrown into a zinc bath to obtain a coating. In a former number we alluded to a machine in the Exhibition for casting nails.—*Mechanics' Magazine.*

NAIL-MAKING MACHINERY.

Mr. C. Gustavson, a Swede, has invented a machine, which supersedes all others by combining in itself the process of rolling, pointing, cutting off, and heading, and producing from bar-iron an excellent Nail at very low cost. The rapidity with which the nails are produced by this invention is truly marvellous. Using bar-iron three-eighths of an inch square, the machine, with the labour of only one man or even a boy, will turn out in a day of ten hours as many as 15,000 three-inch nails. The nails produced are of the very highest quality, the nail being compressed by the rolling process, and always having the grain of the metal in the direction of the length. The nails are formed with fluted sides, which is the most advantageous of all forms, but very expensive to produce by any other process hitherto resorted to. By slightly altering and re-adjusting certain parts of the machine different sizes and forms may be produced. In working iron the bars are heated red hot in a small furnace placed at the side of the machine. The practical efficacy of these nail-making machines is placed beyond doubt by the fact that they have been tested by the experience of two years' constant work.

AMERICAN FILE-MAKING MACHINERY.

The *Commercial Bulletin*, U.S., states that the manufacture of Files by Whipple's Patent Machines is successfully carried on at Ballard Vale, about twenty miles from Boston. The factory is a stone building 276 feet long, 45 feet wide, and three stories high. The machinery is driven by two powerful steam-engines. The steel for the files is cut off the right length by shears. The best quality of cast-steel is used, which, after being cut, goes to the forging shop, where, under nicely gauged trip hammers, the file blanks are forged. From here they go to the annealing furnace, where they are partially decarbonized. After this they are straightened and carried to the grinding room, where they are ground perfectly level, and are then ready to be placed in the cutting machines. Eight files are placed in each machine, where by the use of revolving cutters, the burs are cut. After cutting, and before hardening, each file is stamped by machinery with the name of the Company. They then go to the hardening department and are overlaid with a paste of salt and flour which protects the teeth when heated. The skilful hardener, who is devoted exclusively to this, dips the file into the "lead bath," which heats it to a low red heat, when it is immersed in salt water, and before it is cold it is straightened, if sprung in the process. The paste is then brushed out and the files are put into lime water, remaining twenty-four hours, then taken out, dried and brushed; they are then oiled, which preserves them from rust. Every file is tested by an expert by ringing it upon an anvil, and his accustomed ear detects any flaw. The least irregularity in cutting is rejected.

ALUMINIUM WIRE.

THE problem of drawing Aluminium into Wire has been resolved by M. Garapou, of Paris, an artisan, who now conducts the operation in a truly workmanlike manner. He furnishes the aluminium wire at from 60 to 100 per cent. cheaper than silver wire of the same length. The price of aluminium is always about 200 francs per kilogram. For the purpose of drawing it into wire they commence with rods of aluminium of one mètre in length and twelve millimètres diameter—these the inventor easily reduces to wires of the size of a hair, and many hundred kilomètres in length. These products appeared in the International Exhibition, where were exhibited articles of lace work, such as epaulettes, embroideries, textile fabrics, entire head-dresses, with mounting and ornaments constructed entirely of aluminium. These articles are remarkable for their lightness, and they show that a novel manufacture has been created by the new process of drawing aluminium into very fine wire.—*Mechanics' Magazine.*

ALLOYS OF ALUMINIUM.

Two Alloys of this metal have been manufactured at Newcastle, viz., copper 95, aluminium 5; and copper 92½ to 7½ of aluminium, and called by those working them aluminium bronze. We have examined both proportions, and give preference to the 7½ per cent., especially for colour. The hardness appears quite equal to the best brass, while the colour is that of rich gold; it takes a high polish, and appears to work soundly. We recommend experiments with this latter, namely, 7½ aluminium bronze, to our readers, and suggest that particular attention be paid to the effect of atmospheric moisture with varying temperatures, as it is represented not to tarnish. If such be the case, its employment for the frames of watches and chronometers might save much labour and expense. —*Ibid.*

NEW PRINCIPLE OF SHIPBUILDING.

A VESSEL has been launched from the yard of Mr. J. Robinson, Duke's Dock, Liverpool, in which a new and important Principle in Shipbuilding has been introduced. The vessel draws about 2½ ft. of water, will be able to proceed to sea without any ballast, and will take the ground with perfect safety. She has the peculiarity of being almost flat-bottomed, and from this and other things she is expected to be capable of carrying a very large quantity of cargo in proportion to her tonnage. Her bilge will take the ground at the same time as her keel, which is planked of wood 10 in. in thickness. Her dimensions are—length, 100 ft.; breadth, 22 ft.; depth, 12 ft. 3 in.; and she will carry 440 tons dead weight at a draught of about 11 ft. She will be rigged as a brigantine, with wire rope manufactured by Messrs. Garnock, Bibby, and Co., of Liverpool, but the mainsail will not have any "gaff," the head of the mainsail hoisting up to the head of the mainmast, and gaff-topsail from the head of the maintopmast to

the end of the main-boom, which it is considered will be an improvement, and add to the vessel's sailing powers. The vessel is intended for the conveyance of machinery, and has an exceedingly large hatch with two beams at the end close together, with a large iron rod passing through timbers and screwed on a large iron plate, which makes the beams of the requisite strength without the introduction of stanchions.—*Mechanics' Magazine.*

SHIPS' STEERING SIGNALS.

MR. GISBORNE, late Commissioner for Newfoundland in the International Exhibition, having obtained a patent for the invention of a system of Ships' Steering Signals, has received instructions from the Board of Admiralty to fit the apparatus in Her Majesty's ship *Rhadamanthus*, at Woolwich. The apparatus consists of a couple of boxes, placed respectively on the bridge and in front of the helmsman, which are connected by means of a strong electric cable. On the face of each box are four metal flaps, under which are painted the words "port," "starboard," &c. These are worked by the simple touch of a knob or handle attached to the box, and the orders are replied to in a similar manner, without the slightest risk or danger of the order being misunderstood as at present, by means of the voice. Master Commander Sturdee and the officers of the *Rhadamanthus*, as well as several naval men of experience who have visited the ship since her return to Woolwich, and have seen the instrument, all speak of the invention with approbation.

BOAT-LOWERING APPARATUS.

WE have, from year to year, reported the progress of Mr. Clifford's System for Lowering and Disengaging Boats, the superiority of which to other systems most pertinaciously set forth to supersede it, had been generally acknowledged. We join, therefore, in the following opinion of the unfair treatment which Mr. Clifford has lately received :—We share in the surprise which has been expressed by many naval officers at the tenor of a recent order issued from the Comptroller's Department of the Navy, directing that all new ships of war shall have their boats fitted exclusively with Kynaston's disengaging hook. We consider this order to be arbitrary and unjust. When a legitimate difference of opinion existed, the very least the Comptroller could have done, would be to have left the shipbuilder or officers of the ship to decide for themselves. Why impose such a condition when so many conscientiously consider that Clifford's system is the completest and the best? We assert, with the *Times*, "that Mr. Clifford's boat-lowering apparatus has rendered good service in too many instances to be thus disposed of," and that the Comptroller will have to reconsider his decision preparatory to its revocation.—*Mechanics' Magazine.*

SHIPS' RUDDERS.

An interesting trial has taken place at Portsmouth of a plan, patented by Captain Warren, R.N., for steering ships under steam by a rudder placed in the vessel's bow. The chief merits claimed by Captain Warren for his Patented Rudder are, that it is an auxiliary steering power to the ordinary rudder, assisting the ship to turn quicker when necessary, as might be the case under the fire of an enemy's battery, and also that it should replace the ordinary rudder in the event of any accident happening to the latter, either from the weather or the shot of the enemy. Forward rudders, like screws, require lengthened and expensive experiments to develope their powers, and are almost beyond the means of private individuals. There is, however, no doubt, considerable merit attached to the plan proposed by Captain Warren, but the experiments require to be carried out on a larger and more perfect scale than the above.

PROTECTION OF SHIPS' PROPELLERS.

A trial, by order of the Admiralty, has been made at Portsmouth of the Cunningham plan for protecting the screws of steamships from fouling by underlying warps, wreckage, or other floating material, with a small screw yacht, belonging to Mr. Cunningham, the patentee of the system of reefing topsails from the deck, and fitted with his "Screw Protector," which is a simple application of radius bars from the inner sternpost and deadwood, with chains reaching from them to the ship's quarter and keel, and a network of rope and chain at the water's edge in the run of the ship. The tests first applied were those most likely to occur under ordinary circumstances of losing masts and rigging from the effects of the weather, or from the shot of an adversary, in both instances being supposed to be under steam with the spars and wreckage sucking under the quarters. A boat's spar with loose rigging attached, and numbers of ends of ropes floating, to represent spar wreckage, was thrown overboard from each bow, fore and main chains, checked with guiding lines to bring it under the quarters, the vessel yawed wide over in order to bring the wreckage across the vessel's stern, and therefore as closely as possible in contact with the working screw (the *Swinger* gunboat having the vessel in tow at full speed); but every attempt to bring about a "fouling" failed, and the "protector" proved to be thoroughly efficient. These tests were next repeated at half speed, and were attended with the same results. A quantity of ropes, coir, and hemp, was next made up in loose coils and flung overboard from each bow, and also from the chains on each side, and the whole mass, with their numerous floating loose ends, were checked along the sides of the protectors to give every chance of fouling the screw. This was, however, again found to be impossible, and further experiments in this direction were therefore abandoned. In the concluding experiment the schooner was made fast from its stem to the gunboat's stern with a short length of hawsers,

the gunboat then going a-head at full speed, when the spar and wreckage were thrown over from the gunboat between the ends of the protectors over the schooner's screw. It, as a matter of course, became fouled at once, and gave an illustrative proof of the want of some means of protection from floating wreck, hawsers, &c., of our ships of war when under steam. The experiments were considered of a most satisfactory character.—*Times.*

DISC PROPELLER.

MR. J. J. ASTON, the inventor of this new propeller, has exhibited its action by means of a model, in a long trough of water. The Propeller consists of Discs attached to the axle of a crankshaft, instead of the ordinary wheels with float-boards. The discs are, in fact, wheels without the float boards, which have hitherto been considered necessary to take hold of the water for the purpose of propelling a vessel. The discs were, on this occasion, made to revolve by clockwork machinery; they were formed of very thin metal, and passed through the water without causing any disturbance on the surface, or back water at the stern, and surprised all who were there by their efficient performance. It is claimed for the invention that "it is the most economical propeller ever invented. It entirely prevents that disagreeable and injurious vibration of the boat and machinery, caused as well by paddles as by screws. It does its work in a manner much more agreeable to passengers; at the same time producing a very important saving in the wear and tear of the boat and machinery."

VENTILATION OF SHIPS.

A NEW apparatus has been erected on board the *St. Vincent*, training ship at Portsmouth, by Mr. Wilson Phipson, C.E., of London, for Ventilating the 'tween-decks of Her Majesty's ships of war. The apparatus consists of an air-shaft or cylinder, 4½ feet 3 inches in diameter, continued in lengths from the upper to the lower decks. The first length from the upper deck, being made of sheet-iron, contains the fan, at a level with the ceiling of the main deck; and the remainder of the lengths between each deck are of sailcloth. The fan is worked from the main deck by a small two-horse power vertical engine. This fan consists of two blades, set at an angle of about 50 degrees, regulated by a spring placed on the spindle. Above the fan is placed a dial to indicate the amount of air supplied to the decks below. The amount supplied by the apparatus on board the *St. Vincent* is 508,000 cubic feet per hour. There is no perceptible draught, it is said, produced. So far the experiment on board the *St. Vincent* appears to have been successful; but the *St. Vincent* is not a seagoing or even an efficient war ship, being merely a harbour training-ship, with a free communication fore and aft her lower deck, and without the machinery, stokeholes, and compartments below of our iron ships. —*Builder.*

Another account in the *Mechanics' Magazine* states:—Mr. Wilson Phipson proceeded to explain his apparatus, and made experiments by filling the deck with smoke, to point out the manner in which the air was renewed and the time required for its renewal. The fresh air enters by an artificial patent windsail, containing a ventilator, which is connected with a two-horse power steam-engine. Things are so arranged that with 40, 50, 60, or 80 strokes of the piston per minute, 4, 5, 6, or 800,000 cubic feet of pure air are supplied per hour. The supply given depends upon the number of individuals, each person requiring a certain amount of air per minute, and the apparatus is so disposed that an amount a little greater than can ever be required is furnished by the machine without any perceptible draught. The air, it appears, enters the deck in cyclones which are bipolar, or composed of two curves, a curve of maximum and a curve of minimum velocity. The quantity supplied is indicated at any moment by the needle of a dynamometer connected with the ventilator. The expense of this ventilation, supposing 700 men on board, is about seven-tenths of a farthing per man per night.

SPRAY SUPERHEATING STEAM-ENGINE.

A SHORT time since a patent was taken out in this country to generate steam on an ingenious principle, and we now see, from the *Scientific American*, that a steam-engine working on the principle may be seen in New York. "We will briefly state," says that journal, "wherein the invention differs essentially from the ordinary steam-engine. For the latter, as everybody knows, a boiler is used containing a considerable quantity of water, to which the heat of the furnace is most directly applied, and from which the steam is generated. Such a boiler is a magazine of force, because it contains a far greater amount of steam and heated water than is required to supply the engine at each stroke. Herein consists the danger from explosions in common boilers. A hot-air engine has no magazine of force like a steam boiler. Its heater is supplied with the exact amount of air requisite for each stroke, hence its immunity from explosion. This new engine embraces a similar principle. It has a peculiarly-constructed heater, into which the exact quantity of water for each stroke is fed, in the form of spray, then it flashes into steam and passes over an extended heated surface to the working cylinder." The engine exhibited is single-acting, and of the following dimensions:—

Its steam cylinder is 7 inches in diameter; the stroke of piston, 7 inches. It is situated upon a small tank 30 by 34 inches, which forms the bedplate and the heater of the feed water. The feed pump has a stroke of one-fourth of an inch, and the water is fed through a ¼-inch pipe, the steam heater, outwardly, resembling a vertical cylindrical stove. It is 13 inches in diameter, and 30 inches in height. There are 19 double tubes inside, and the steam passes between these and is heated on two sides. The circular grate containing the fire is capable of being adjusted by a lever and set at any required distance from the bottom of the heater. We have examined this engine working with superheated steam at 60-pound pressure, and running at the rate of 87 strokes per minute. The steam exhausts into the tank upon which the engine stands; the

feed water, nearly at the boiling temperature, is conveyed into the heater in a fine shower through a small conical chamber on the top of the heater. A small quantity of superheated steam is contained in the heater, and the feed water, in the form of spray, is instantly converted by it into saturated steam. The pipe for supplying the cylinder with steam is situated nearly at the bottom of the heater, hence the saturated steam formed from the feed water at the top of the heater has to pass in a current between the double tubes on its way to the cylinder, and it thus flows over a very extended heating surface and becomes superheated. A constant current of steam is maintained in this manner over the heated surfaces of the tubes. By such a heater, and such arrangements of the parts of the engine, nearly all the heat is economized, and a perfectly safe steam-engine is secured. If the feed pump were to cease working, or the supply of water to become exhausted, the heater would become like an empty oven after a few strokes, and the engine would stop of itself. For pumping water, printing presses, sawing wood, and various operations requiring a small motor from 1 to 10-horse power, this engine appears to be well adapted, as it is compact, safe, and easily controlled.—*Mechanics' Magazine.*

SAFETY-VALVES OF STEAM-BOILERS.

AT the Academy of Sciences of Vienna, M. de Burg has described his experiments on the mode of action of the Safety-valves of Steam-boilers. These results are in contradiction with the theoretical propositions upon which the regulations for the dimensions of these boilers have been based: inasmuch as in reality these valves do not rise to a height equal to one-fourth of their diameter, that is, one or more inches, but only so as to leave a passage for the steam whose diameter does not exceed the fraction of a line. These apparatuses, therefore, cannot fulfil their object, which is to give simultaneous issue to all the steam which a boiler can produce when it has reached a determinate degree of tension, and thus to prevent all danger of explosion. To fulfil this purpose they ought to be at least six times, and in some cases twenty times larger than the rules prescribe.—*L'Institut.*

NEW MARINE BOILER.

D. F. GRIMALDI has read to the British Association a paper descriptive of this Boiler, for generating steam of high pressure. It consists of a cylinder nearly filled with tubes, was kept slowly revolving during the time of working. Detailed drawings were exhibited of a boiler of 100-horse power, which occupied less than half the space of ordinary marine boilers of the same power, and was of less than half the weight. The firegrate, placed beneath the boiler, has the whole shell brought gradually over it, the hot gases passing through all the tubes, part of these being covered by the water, and part in the steam space, thus rendering the boiler a steam generator and a superheater. The plan has been tried on land, and details of the experiments were given.

STEAM REGENERATOR.

AT Messrs. Collinge's axle-factory, Bridge-road, Lambeth, experiments have been made with a Steam Regenerator, patented

by Mr. P. Pigna and Captain Fernandez. Without diagrams it is difficult to convey a correct idea of the invention. A pipe receives all the steam that ordinarily escapes after acting on the piston, and condenses it in a receiver forming almost a perfect vacuum, which increases the effective force of the steam on the piston. By means of a special pump the condensed steam is sent through the regenerator, and thence by a second pipe into the boiler, which it reaches completely regenerated, and ready to act again on the piston in all its original force. The regenerator is applicable to all steam-engines, without alteration to the engines themselves; and among the results claimed for it are,—a saving of more than 99 per cent. of the feed-water, a proportionate reduction in the bulk and weight of boilers, and a saving of 50 per cent. in the fuel required for high-pressure engines, and of 32 per cent. for low-pressure engines. The honour of the invention is said to belong, as regards its scientific portion, to Mr. J. Imray, an English engineer, and to Mr. P. Pigna, an Italian engineer; and, as regards its practical details, to Mr. F. Datichy, a French mechanician. The experiments were considered highly satisfactory.

THE FIRST STEAMER IN ENGLISH WATERS.

LETTERS have appeared in the *Glasgow Herald*, in which the honour of putting the First Steamer on English Waters is claimed rightly for the Scotch shipbuilders; but the writers of these letters do not agree as to the particular vessel to which the honour is especially due, the *Margery* and the *Caledonia* being both named. In one of the letters referred to the following paragraph from the *Greenock Advertiser*, of the 12th of May, 1857, is quoted in favour of the claims of the *Margery*:—"This vessel was taken south, along the east coast of Scotland. When she reached the Thames the English fleet were at anchor; she passed close. The extraordinary apparition excited a great commotion among officers and men; none of them had ever seen a steamer before, and by some of them she was taken for a fireship. She was hailed by the nearest man-of-war, and, being answered that she was a steamer, built at Dumbarton, on the Clyde, a seaman from Dumbarton (alive in 1857) ran along the deck of the man-of-war, shouting 'Hurrah for Scotland; Dumbarton for ever!' In corroboration of this statement we beg to add that the steamship statistics of the Thames clearly show that the *Margery* was the first steamer which appeared in that river. The *Margery* was built here (at Dumbarton) in 1814, by Mr. William Denny, sen., the father of those eminent shipbuilders our townsmen, the Messrs. Denny, for Mr. Andrew Shearer, of West Kilpatrick. She was 56 ft. long, and 19 ft. in breadth over all. In leaving for London she was taken through the Forth and Clyde Canal, and coasted up to London. It was on this voyage that she passed through the fleet, and created so much surprise. The

Dumbarton seaman referred to in the paragraph quoted was John Richmond, who in his latter years was employed in the shipbuilding yard of Messrs. William Denny and Brothers, and died a year or two ago." The *Margery* appears to have been sent to London towards the close of the year in which she was launched, and continued for many years to ply as a passenger steamer on the Thames, till finally she was broken up not very many years ago, and where she was held in great repute as the pioneer steam-vessel.—*Dumbarton Herald.*

VOYAGES OF THE "GREAT BRITAIN" STEAMSHIP.

To the passages of this extraordinary vessel must be traced the first practical application, on a large scale, of steam used as a secondary, and not as the principal motive power in a vessel; and the remarkable regularity of her passages sufficiently proves that such an adaptation can alone accomplish a voyage of upwards of 13,000 miles, in a moderate length of time and at no excessive expense. Going back to 1858 we see that her passage out in November was made in 64 days; home in 67. The succeeding passage in 57 days out, and 62 days home. The next passage was 62 days out, and 68 days home. The following passage 63 days out, and 66 home. The result of three years' passages clearly demonstrates that the use of steam as an auxiliary enables the length of the voyage to be reckoned upon with certainty, within a day or two, and contrasts favourably with the uncertain and often protracted passages of the merely sailing vessel.

THE "GREAT EASTERN."

ACCORDING to the *New York Times*, Sept. 24, the mammoth ship still lay in Flushing Bay, where the damage sustained by running on a rock off Montauk Point, on her last trip to this port, was being repaired. We learn that the reports of experienced divers show that the ship's bottom was opened by the rock along a single line of her outer plate for a distance of several feet. The inner "skin," or hull of the ship, was not touched, and remains as dry as on the day of launching, and the vessel could proceed on her voyage across the ocean to-day with more safety than can any vessel having but a single hull. Nevertheless, her officers and agents are pushing forward her repair by a very simple method, tried once before in Milford Haven with entire success, and which has the entire approbation of distinguished American engineers. The mode is curious, and interesting as it is simple. A large scow, with sides of proper height, is preparing to be used as a coffer-dam. It is made to fit the bottom of the vessel at the point of fracture, and its edges are padded so as to close perfectly over any inequalities that may be found upon the hull. At the side of the scow (or coffer-dam) are two shafts or man-holes, which will pass up the side of the ship, reaching above the water's edge when it shall have been adjusted to its place.

The scow when sufficiently sunken will be floated under the ship's hull, and fastened securely in position by chains hove taut. This done, pumps inserted in the man-holes will free the scow of water, and admit the men and materials to repair the damage. It was believed there would be no difficulty in making the vessel just as perfect as before she touched the rock. A few days more would give the result of the experiment, if that could be called such which has already been once successfully accomplished. In the meantime advantage was taken of the opportunity to thoroughly overhaul, paint, and refurnish the *Great Eastern* from stem to stern.

DOUBLE SCREW STEAMSHIP, "FLORA."

THE trial of this vessel, which took place on Nov. 7, on the Thames, was attended with an unusual degree of interest, in a public and official sense, from the fact that the peculiar form of the vessel's construction and the disposition of her propelling steam power, if successful on trial, combine the requisites required for our smaller ships of war, such as corvettes of the *Chanticleer* and *Rinaldo* class, and smaller craft, as gun-vessels of six guns and less; inasmuch as she was the representative of a class of ship capable of carrying a heavy armament of guns, with a large engine power, at a light draught of water, possessing at the same time a power of manœuvring in a small space, such as could not, under any circumstances, be possessed by a vessel with the ordinary single screw. The *Flora* is an iron vessel of 400 tons, 160 feet in length, 22½ feet in breadth, and 15½ feet in depth, having two independent engines and screws with a collective nominal horse-power engine of 120 horses, the screws working under each quarter, and consequently before the rudder, in lieu of the present system of one screw astern and abaft the rudder. The diameter of the cylinders is 26 inches, with a stroke of 21 inches. Each screw has a diameter of 7 feet, with a pitch of 14½ feet. The boilers comprise two tubular, working at 30 lb. pressure, and one high pressure, working at 50 lb. This high-pressure boiler is intended to be used for producing a steam blast in the chimney and to dry the steam (by admixture) from the two common boilers. The vessel is schooner-rigged, and without yards or any extra weight aloft, giving promise of being a real steam clipper—a promise which her performances under steam during the day fully confirmed; for, if her tonnage and horse-power are fairly considered, there can be no doubt the *Flora* is the fastest screw steamship afloat. Her builders are Messrs. Dudgeon, of Millwall, both of hull and engines. There is nothing new in the idea of the use of two screws in the propulsion of ships, as our old floating iron-cased batteries are each fitted in the same way, but are worked by one motion from the engines. The *Flora*, however, is the first vessel that has been fitted with two screws and engines working separately and independently of each other;

and herein lies the value of the principle in a military point of view, as giving a ship a means of rapidly revolving under steam and changing her position to any required point.

RAILWAY MERRIMAC.

WE find in the *Charleston Mercury*, July 12, an announcement of this terrific war implement and its employment. It is an iron-clad battery, mounted on seven sets of wheels, and carrying one large rifle gun. The whole machine is propelled by an ordinary locomotive. It was estimated that the loss to the enemy in one engagement with this novel craft had been between 800 and 1000 in killed and wounded. How important a part was played by the railroad battery in this engagement may be conjectured by the statement of a prisoner who was captured on the occasion. He stated that the second shell thrown into the ranks drawn up in a field, killed and wounded 100 men and 30 horses. It is believed, also, to have done great execution in the woods, and contributed, by the terror inspired by its immense missiles, to the easy rout of the entire division of the enemy.

SMITH'S LOCOMOTIVE BATTERY.

THIS is a design for a small one-gun Battery intended to travel on common roads. It is the invention of Mr. F. Smith, of Fer Hill, Droxford, Bishops Waltham, Hants. The battery is proposed to be constructed of iron of sufficient thickness to resist the shot from such artillery as usually accompanies an army "on the march;" its dimensions to be 24 ft. in length, 12 ft. in height, and 16 ft. in width. These proportions, it is thought, will allow of its passing easily along turnpike roads, whose minimum width is fixed by law at thirty feet. The battery is intended to be propelled by steam machinery similar in character to Bray's traction engine; but as the weight must be very great, however skilfully the work may be constructed, the inventor has devised a means of preventing accidents and consequent delays caused by the wheels that support the battery breaking through the crust of the road. He proposes to place behind the fore-wheels of the engine a horizontal roller of the entire width of the machine, measuring from outside to outside of the axle-boxes, so that, should the small wheels sink below a fixed limit, the weight of the engine is at once transferred to the larger bearing-surface of the roller. Light and air are admitted through a strong grating on the top of the cupola as well as through the ports and between the bottom of the cupola and the ground, where an opening is left to allow the battery to pass over stones and also to allow for inequalities in the road. When in action this space will be closed up by an iron skirting, which will be lowered down from the inside. The battery will be armed with one rifled pivot-gun and twelve breech-loading rifles. The inventor believes he can construct a battery that, with its armament and stores shall not exceed the maximum weight that ordinary roads

and bridges may be supposed able to bear.—*Illustrated London News.*

GIRARD'S NEW RAILWAY SYSTEM,

CHEMIN DE FER GLISSANT, has been described to the Academy of Sciences at Paris. He suppresses the use of wheels, springs, &c., and transforms the carriages into sledges. To diminish the friction he makes the carriages rest on a species of hollow clogs, which move on large rails, and he introduces into these clogs water under pressure. This water, in seeking to escape, prevents all friction of metal upon metal; the carriages really sliding on a thin layer of water, and resistance being almost annihilated. He at first thought of employing compressed air, but the necessity of constantly greasing the rails compelled him to renounce the idea. With water there is no difficulty; and sand or dust produces no inconvenience. Through the munificence of the Emperor, M. Girard has constructed a horizontal line of fifty yards long. He says, in conclusion, "The results obtained by numerous experiments are such as to dissipate all doubts as to the possibility of realizing the ideas which I have put forth on this subject."

NEW RAILWAY PROPELLER.

AN experiment has been made at Nancy with a new Propeller on a temporary railway constructed with rails lent by the directors of the Paris and Strasburg Railway Company. As the inventor asserts that his propeller is capable of exerting the greatest force, and of propelling railway carriages at the greatest speed, the question of force alone was the subject of the experiment. As the road was prepared so as to present the greatest difficulties, such as an ascent of three centimètres the mètre, and two successive curves of a radius of 60 ft., it would have been dangerous to proceed at a greater speed than that of an ordinary French train (about 35 miles an hour). The success of the experiment was complete as to the regularity of the action of the propeller. It was admitted by all present that the motion was uniform and without any sudden shock.

NEW TANK LOCOMOTIVE.

THE *American Railway Review* says: The Tank Locomotive named the Monitor, built by Danforth, Cooke, and Co., for the Hudson River Railway, has some novelties worthy of especial notice. It has one pair of drivers, five feet, and two trucks; the front truck under the smoke-box, the other under the tank, behind the foot-plate. The coal-box is over the tank; it has an inclined bottom, the tank-top sloping upward to the water entrance. It holds water for about twenty miles. The fuel is Cumberland coal. The chimney is double—the inner chimney being raised or lowered by the engineman, as he wishes to vary the draught. It has two feed-

water heaters, situated close behind the smoke-box, which is square-bottomed. The cylinders, judging from sight, are about 10 by 18. We shall, as soon as convenient, obtain the dimensions of all parts of this engine. We hear that its performance is entirely satisfactory with a train of three first-class passenger-cars. Its usual train is two. It runs the Yonkers train, stopping at all stations, and keeps its time without difficulty.—*Mechanics' Magazine.*

IRON RAILWAY BRIDGE FOR INDIA.

THE third of a series of twelve spans which are to constitute an Iron Lattice Bridge over the river Jumna, near Delhi, has been completed by Messrs. Ormerod, Grierson, and Co., of Hulme. The bridge is for the East Indian Railway Company, and is from designs by Mr. A. M. Rendel, C.E., London. It is constructed so as to answer the double purpose of a railway and an ordinary road, the railway being along the top, and the roadway beneath it. Each girder is 216 feet long, and this gives a clear span of 205 feet between the piers, of which there will be eleven. The twelve spans will therefore form a structure having a total length of over half a mile. Confining attention to a single span as representing the main features of the entire bridge, it may be described as consisting of two principal girders, with two tops and two bottoms, formed of ⅜-inch plates; each top and bottom being united by diagonal lattice-bars, so as to form one main girder, which is united to a similar one transversely by means of strong cross girders. Between the upper side of the lower roadway and the under side of the railway there is a clear height of 16 feet; and the total breadth of the bridge at its centre is 18 feet. It has a slight rise towards the middle, being constructed with a chamber of 5 inches. None of the rivet-holes in this bridge are punched: multiple drilling-machines, five in number, were constructed especially for the purpose. We understand that the Messrs. Cochrane, of the Woodside Ironworks, Dudley, were the first who applied this ponderous machinery to bridge-building. The holes made in this manner, besides being more accurate than when punched, are said to leave the iron much stronger, and its fibre uninjured. The iron has been supplied by the Shelton Bar Iron Company, near Stoke, and was required to bear a tensile strain of twenty-one tons to the inch of section. The breaking strain is estimated at from 2500 to 3000 tons, equally distributed.—*Builder.*

RAILWAY ACROSS THE PYRENEES.

ON August 21, the first Railway Train, drawn by locomotives, crossed the chain of the Cantabrian Pyrenees, over the northern division of the Tudela and Bilbao Railway, from the sea-port of Bilbao to the town of Miranda on the Ebro. The distance between these two towns is about sixty-six English miles, of which over forty are in ascending from the coast to the summit, 2163 ft. above

the sea, being the lowest col or pass in the whole range of the Pyrenees. The average rate of ascent from the sea is 54 ft. per mile; the maximum ascent is 76 ft. The predominant curvature has a radius of only 300 yds., and the curves are continually reversing. There are two points on the line at the entrance of the Basin of Ordima, distant only 600 yds., measuring across the gorge or neck of the basin, which are fully 8½ miles distant from each other in travelling along the line, and which differ 456 ft. in level. The time taken in the transit is 2¾ hrs.; and the scenery, as may be presumed from the locality and from the frequent change of direction on the line, is magnificent and varied. The last glimpse of the northern landscape the traveller has is over the Gujuli waterfall, and down to a depth of 400 ft., to the bottom of the ravine into which it falls. The descent on the southern side is very gradual, the fall being on an average 24 ft. per mile to the level of the Ebro. The total length of the railway is 155 miles—the length of the portion we have described being 66 miles, and the cost of these 66 miles more than 1,000,000*l.* sterling. The cost of the whole line, stations, rolling-stock, &c., was 2,500,000*l.*, all the capital being Spanish money, chiefly subscribed in Bilbao and its commercial connexions. Not a share is held out of Spain or its colonies.—*Mechanics' Magazine.*

HORSE RAILWAY IN SWITZERLAND.

The Horse Railway from Geneva to Carouge—the first section of the lines of horse railways to be constructed in the canton of Geneva under the concession granted to Mr. Burn, C.E., has been opened with the greatest success. The opening of the line was celebrated by a local *fête* at Carouge, when 7000 people were carried from Geneva and back. The fares on this line are the lowest ever attempted, and amount to a fraction more than three farthings per passenger per mile. This is the first line of horse railway that has been laid down on the Continent on the American system. The rail used is a grooved rail of peculiar form, which presents no obstruction or inconvenience to the ordinary traffic of the roads.

GILES'S NEW TRACTION-ENGINE.

All engines previously constructed have had their tractive efficiency based alone on *friction;* that is, the centre of gravity is brought over the driving-wheel, and the adhesion to the surface (over which the engine travels) is due solely to the hold which is afforded by the circumference of the wheel rubbing against the ground.

In Giles's Engine the direct agent of Traction is gravity, friction being used only as a foundation on which to develope a far higher and more efficient principle of adhering to the surface of the earth. The wheels of the engine merely carry its weight, while the

tractive effort is the combined operation of the two forces in action, viz., the power of the steam and the law of gravity.

The application of this principle to the science of locomotive mechanics opens up an entirely new field for the enterprise of engineers, as well as the capital and industrial interests of the nation, only limited in its extent by that of the untilled and untrodden world. By its agency iron and steam can overcome all tractive operations now performed by animal labour with the utmost reliability and success.

An engine constructed on this principle can now be seen in operation on application to the inventor, John Giles, 69, Basinghall-street.—*Mechanics' Magazine.*

EXPERIMENT WITH A TRACTION-ENGINE.

AN experiment illustrating the power of Bray's Traction-Engine for drawing ponderous loads, almost impracticable to horses, along our public thoroughfares, has taken place in the metropolis. A large wrought-iron girder, of the hog-back construction, 74 feet long, 5 feet 8 inches high in the centre, and weighing 20 tons, had to be removed from the works of Mr. H. Grissell, to the Manor-road, Dulwich, there to form part of a bridge for the London, Chatham, and Dover Railway.

The journey had to be performed between 10 p.m. and 6 a.m., the hours to which the use of traction engines is restricted by the police regulations within the metropolitan district. The first difficulty was how to get the huge, unwieldy mass out of the yard where it had been constructed. Placed upon rollers, it had to be raised by means of jacks to a height of six or seven feet from the ground. Two strong trucks were put underneath it, the one in front being a large four-wheel boiler truck, and the second, which bore the weight behind, a very heavy "trolly" with two wheels. These trucks together formed the carriage, the girder being kept in its position by stout chains passing over it and under the trucks. A wooden bolster was placed under the load on the larger truck, with a swivel between the fore and hind wheels, by the action of which facility was obtained for turning corners with comparative ease. Naphtha lamps, to light the workmen and give warning to all passers-by, were fixed along the whole line of the girder; and thus equipped, with the traction engine yoked in front, the massive load went upon its journey. It was daylight when the final destination (Dulwich) was attained. The experiment was eminently successful. Loads quite as heavy have been taken through the streets of London before; but we understand that this was almost the first combining such length (24 yards) with so great a weight (20 tons). It would have required 25 horses to draw it by the ordinary method, and the difficulty of getting such a number of animals to pull all together, to say nothing of the obstruction they would cause to the regular traffic, may be readily imagined.—*Times.*

THE PNEUMATIC DISPATCH.

We described this invention in the *Year-Book of Facts*, 1862, p. 72. The London and North-Western Railway Company having granted a site for a station and receiving-house, rent free, at Euston-square, a few yards from the Clearing-house, the directors of the Pneumatic Dispatch Company at once commenced operations by laying down beneath the roadway of Upper Seymour-street a line of iron tubing about half-a-mile in length, and extending from that terminus to the post-office in Eversholt-street, under the superintendence of their engineer, Mr. T. W. Rammell. Within the iron tube, which is about 2 ft. 9 in. high and 2 ft. 6 in. wide (its section being similar to that of a railway tunnel in miniature) are two small ledges, or rails, on which the wheels of the small cars bearing the parcels will run. These will be propelled backwards and forwards, on the signal being given, by the exhaustion and pressure of the air in the tube. The immense disc and chamber in which it revolves have been removed from Battersea, and erected within the walls of the station and receiving-house. The disc, or wheel, is 21 ft. in diameter. It is composed of three sheets of wrought-iron, the two which form the outside being each about an eighth of an inch in thickness, while the centre and smaller plate is about a quarter of an inch thick. These are screwed on to 16 spokes, which radiate from the centre of the wheel, and thus form 32 cavities, there being a distance between the plates at the rim of nearly two inches. Air-chambers pass beneath the disc, which are exhausted by its revolutions in the race chamber. The wheel will be worked by a diagonal direct acting high-pressure engine of about 15-horse power. As regards the speed which will be attained, the railway company have only stipulated for a *minimum* of 15 miles, but from experiments it has been shown that a speed of 35 miles can be attained.

M'CORMICK'S NEW REAPING-MACHINE.

This new machine is entirely founded upon M'Cormick's old machine as made by Burgess and Key, the new patent consisting simply in the introduction of an automaton rake, which, at regular intervals, by one rapid sweep, draws the corn on the platform together, and, with a quick turn, throws it aside in a loose sheaf out of the way of the machine. The mechanism by which this is effected is simple in the extreme, though, from its very simplicity, it is difficult to give a clear idea of it to the general reader. Putting it in its briefest form, we may say that the wheels on which the old machine was drawn along the ground set in motion a mechanism by which the corn was cut close off at the ground, and at the same time revolved a light four-armed wooden fan or gleaner, which as fast as the corn fell pushed it on to the platform. This, in substance, is the old machine. The new one consists in the addition of the automaton rake, which has two actions. During one part of the revolution of the gathering fans it acts with and as-

one of them till its wooden teeth are level with the platform, where the cut corn lies. It then ceases to revolve, and by a most ingenious piece of mechanism, makes a sudden horizontal movement, throwing aside on to the ground the entire sheaf, and instantly after resuming its motion as one of the revolving fans. This machine has been tried once before in England among some of the heavy Eesex crops, when its performances exceeded the most sanguine expectations.

IMPROVED ROAD-MAKING.

A French inventor has designed a steam roller to consolidate gravel and macadamised Roads. A pair of cylinders, inclined at forty-five degrees, act on an outside crank on one end of the axle of the main roller or drum. The front axle has wheels as broad as can be, and is controlled by steering-gear similar to that used on steam-carriages and traction engines. It is said that this machine will be better than horse-drawn rollers, because it can run both backwards and forwards with equal facility, be easily reversed, and work on a short piece of road until it is sufficiently consolidated; and it does not impair its own work by digging it up, as horses' feet do.—*Mechanics' Magazine.*

UTILIZATION OF THE TIDES.

LET us suppose (says a writer in the *Chemical News*) that by the action of the Tides the difference of level of the surface of the ocean at a certain spot is 21 feet between high and low water. Omitting for the present all consideration of the power of the subjacent liquid, what is the mechanical value of a space of 100 yards square of this water? 100 yards square by 21 feet deep equal 70,000 cubic yards of water, which is lifted to a height of 21 feet, or to 1,470,000 cubic yards lifted to a height of 1 foot. Now, since one cubic yard of water weighs about 1683 lb., 1,470,000 cubic yards weigh 2,474,010,000 lb., which is lifted in six hours. This is equivalent to lifting a weight of 412,335,000 foot lbs. in one hour; and since one horse power is considered equivalent to raising 1,800,000 foot lbs. per hour, we have, locked up in every 100 yards square of sea surface, a power equal to a 230-horse-power steam-engine; acting, be it remembered, day and night to the end of time; requiring no supervision; and costing nothing after the first outlay but the wear and tear of machinery. By means of appropriate machinery connected with this tidal movement, any kind of work could be readily performed. Water could be hoisted, or air compressed, to any desired extent; so as to accumulate power for future use, or for transport to distant stations. Light of surpassing splendour could be generated by means of magneto-electric machines; and, with a very little exercise of ingenuity, every lighthouse on the coast could be illuminated with sun-like brilliancy, and with absolutely no expenditure of fuel.

SEWAGE OF TOWNS.

THE Evidence given before the Commons Select Committee on utilizing the Sewage of Towns, which has now been published, recognises several important principles as established. It shows that sewage contains the elements of every crop which is grown, and that as compared with solid manure there are advantages in its application to land, there being no loss from evaporation, and every particle of it coming into immediate action on the crop. It permanently improves land, its good effects being visible for years. Sewaged grass has a great effect in increasing the quantity and richness of the milk of cows as well as improving the condition of the cattle. The evidence shows that the earth possesses the power to absorb from the sewage all the manure contained in it, provided it be not applied in too large quantity, but the crops are only benefited by that portion which is absorbed by the soil within reach of the roots. Mr. P. W. S. Miles, applying the sewage of 30 persons to 14 acres of ground, arable and pasture, obtained on the lowest estimate a clear profit of above 1*l.* a year for the sewage of each person, whereas on the other hand, at Rugby, Mr. Lawes, with his heavy dressings of sewage, from 3000 to 9000 tons an acre per annum, could only recover back in produce between 1s. and 2s. per head per annum. In Mr. Miles's case, the earth had full power to extract from the small quantities applied all the manure which the sewage contained, but in the case of Mr. Lawes a large portion flowed off the surface and was lost, and a further portion must have sunk beyond the reach of the crop. Mr. Westwood, of the Anerley Schools, obtained a gross return of 9d. for every ton of sewage applied to Italian rye grass, 1500 tons to an acre in the year; and Lord Essex, applying sewage water to wheat, 25,000 to 30,000 gallons an acre, obtained a clear gain of 47s. an acre. These are profits which will pay for the use of sewage, and the experiments at Malvern, as well as those at Anerley, show that with a full supply of sewage little or no artificial manure will be required.

The evidence shows that sewage may be applied with advantage to every description of soil which is naturally or artificially drained, and that throughout the entire year except in hard frosts. Sewage, in the state in which it is found at the outfall of the sewers, even in the hottest weather, is described as very slightly offensive, and if applied to the land in that state there is no fear of nuisance, as the soil possesses the power to deodorize and separate from liquids all the manure which they contain, provided too large a quantity be not applied, overtaxing the capacity of the soil. So completely is it purified by percolating through land, that Sir J. Paxton suggested to this committee that it is desirable to apply the sewage and wash of the metropolis to agricultural purposes as much as possible in districts where the water will flow back into the upper portion of the Thames, so as to preserve to London the advantage of a large

flow in the river as it passes through the town, notwithstanding the increasing abstraction of water for the use of a population increasing at so enormous a rate.

VALUE OF TOWN SEWAGE.

In a lecture to the Royal Agricultural Society, by Dr. Voelcker, on the Value of Town Sewage, Mr. Hofmann, he said, had estimated that the fertilising matter of sewage was worth about 2d. per ton, or 17s. 7d. per 100 tons. And taking the fertilising property in the London sewage at the estimate of 90 grains of solid matter per imperial gallon—though that was a high average—the sewage of London would be worth 3796*l.* per diem, or 1,385,540*l.* per annum. The calculation of the value of sewage, however, was always made by a comparison with Peruvian guano, which was taken at 11*l.* per ton, and it was hardly fair to compare the dry matter of sewage, of which one-third only was valuable, with a material like guano, which contained scarcely any worthless matter at all. He considered that a ton of the solid matter of London sewage was worth for its ammonia 4*l.* 1s. 6d., at 6d. per lb.; for its potash, 17s., at 3d. per lb.; and for its phosphoric acid, 3s. 2d., at 2d. per lb. By this calculation a ton of London sewage would be worth for its fertilising properties 1¾d. However, it would be very fallacious to draw the conclusion that, because the fertilising materials in a ton of sewage were worth that amount, its value as a manure to the farmers must be estimated at that price in the same way as guano was when sold at 11*l.* per ton. They must consider the bulk in each case, and the worthless matter in sewage. An interesting discussion took place at the conclusion of the lecture; and, in reply to questions, Dr. Voelcker remarked that anything that was grown very quickly was inferior in quality to the same kind of thing that was grown more slowly: but, of course, it was quite another thing whether it was not more profitable to producers to have the large increase in quantity, although it was attended by some degree of inferiority.

SEWER VENTILATION AND DEODORIZATION.

An official report has been made by Mr. Haywood, the engineer and surveyor to the City Sewers Commission, and Dr. Letheby, their medical officer of health, as to the experiment with charcoal in Sewer Deodorization and Ventilation on Dr. Stenhouse's principle.

The district experimented upon is in the eastern portion of the City. It includes a space bounded by Bishopsgate-street on the west, from Cornhill to Widegate-street; by Middlesex-street and Somerset-street on the east to the City boundary; and by the Minories and then by Leadenhall-street to Cornhill on the south; the whole of the main thoroughfares above-named being included in the area. It comprises a space of about 59 acres, with about 1700 houses, and about 14,000 inhabitants.

The points to which attention was directed by the two reporters were the following:—

"1st. The deodorizing power of the charcoal.

2nd. The length of time that the same charge of charcoal will continue to deodorize the sewer gases.

3rd. The effect the air filters have on the ventilation and temperature of the sewers.

4th. The exact cost of the experiment, so as to obtain data from which to estimate the probable expense of the process if it were applied to the whole city, or even to the metropolis."

The deodorizing power of the charcoal (continues the report), has been satisfactorily proved to be complete. Not only have there been no complaints from the public of stenches from the ventilating gratings, but we have ascertained by actual observation that the odour of the sewer gases is not perceptible when they have traversed the charcoal.

As to the duration of the powers of deodorization, the reporters state that they have hardly sufficient proof. The charcoal seems to lose much of its power when saturated with water: this we ourselves anticipated. If kept dry, the charcoal would not require renewal oftener than once a year; but in the existing circumstances it required renewal once a month.

As to the effect of the air-filters on ventilation, the reporters state that they cannot give a very positive opinion. The ventilator did not seem to be so perfect as in other cases; but the differences as to temperature which denoted a difference of degree in ventilation were extremely slight. Danger to workmen in the sewers has not been materially increased by the application of charcoal to the ventilators. The reporters recommend charcoal respirators for the use of these men.

The general conclusions from these experiments and from the consideration of collateral evidence are—

"That dry charcoal in the presence of atmospheric air is a powerful means of destroying the mephitic gases and vapours of sewers and house drains; that the charcoal filters may be used with efficacy in the course of the air channels from the drains and closets of houses, as well as in the ventilation of the public sewers; that, in applying the charcoal, those contrivances should be used which offer the least resistance to the free passage of the air; and, lastly, that the situation of the filters is best when the charcoal is protected from wet and from dirt, and is easily accessible."

THE MARSHLAND DELUGE.

By this disaster, which occurred in May last, the waters of the Middle Level of the Bedford Level were precipitated over the neutral district of Marshland, and some 10,000 acres of the best corn land in the country were deluged. The difficulty of stemming the catastrophe is thus described in *The Times*:—

A great engineering difficulty occurs in obstructing the ingress of the tides. The surface of the flat tract lies 15 to 17 feet below the level of high water at spring tides; and the salt water, having free ingress, with so great a fall, pours impetuously into the district, as one attempted dam after another is carried away by the

stream. Local engineers predicted the failure of the means hitherto employed, declaring that sufficient materials must be collected before operations are begun; and then the simultaneous driving of a large number of piles on each side of the stream, and securing the heads of these by braces and shores to the banks, and even chains and anchors in the bed of the drain, until another set of piles can be driven, would securely check, or "throttle," the current; and the piling, beginning with a broad base at each bank, might be gradually advanced until the opposite jetties met and closed the channel. This is partly the course since pursued with long screw-piles, under the superintendence of Mr. Hawkshaw's engineer, Mr. Smith.

But the alarm of the population in the Middle Level was not so much from any dreaded inroad of salt water as from the necessity of discharging the drain-water of 130,000 acres when their outfall is blocked up.

The anxious inquiry then was—How far were the old outfalls available for the safety of the immense tract suddenly deprived of its drainage, and which must wait through at least one winter before the sluice could be rebuilt?

It had been decided to separate the Middle and South Levels; and the proprietors of the Middle Level had already taken a great step in that direction. Their existing drainage being very incomplete, and particularly a large lake called Whittlesea Mere being altogether incapable of drainage, they obtained an Act for making a new drain from their level to the Eau Brink Cut, which had greatly improved both drainage and navigation. This "Middle Level drain" was completed in 1852, at a cost of over 400,000*l.*; the drain is about 11 miles long, perfectly straight, and devoted exclusively to drainage, there being no navigation. Its outfall into the Eau Brink Cut (about three miles above Lynn) was secured by a sluice which cost 30,000*l.*, and by which it is said the contractor lost 10,000*l.*

The drain, although made for the sole benefit of the Middle Level, runs through a district called Marshland, lying between Lynn and Wisbeach, and forming no part of the Bedford Level.—The Marshland fens, from reedy swamps, have been converted by drainage and cultivation into good corn land, almost equal in value to that of the rest of Marshland, which is one of the most fertile districts in England.

On Sunday, the 4th of May, the Middle Level Sluice blew up, the cause being, that the tidal waters had gradually undermined the brickwork and formed a hole in the bed of the river, in which the structure was engulfed. Whether this took place without warning is a controverted point, which may result in litigation.

It was now evident that unless some means could immediately be adopted for excluding the waters of the Ouse from the Middle Level drain, the banks of the latter (constructed only to resist the fresh water from above) must give way. Attempts were made to make a dam across the drain, but they failed, and on Monday

morning, the 12th of May, under the weight of a high spring-tide, the west bank of the drain broke, and the roaring tide, which had previously nearly overtopped the bank, poured into the adjoining fens, carrying away the bank for about 70 yards, and making, it is said, a hole ten feet deep where it had stood. And at every subsequent tide the water poured over the defenceless country, until it is supposed that nearly 10,000 acres were submerged—all a few days before verdant with luxuriant crops.

It was useless to attempt to get the water off the fens until the Middle Level Commissioners had secured their banks, so as to relieve the unfortunate fenmen from fear of further inroads. The Commissioners for this purpose gave *carte blanche* to Mr. Hawkshaw, the engineer.

To detail the several operations would occupy more space than our limits will allow. In September last, the siphons which had been in course of construction for some months past, for discharging the waters of the Middle Level Drain over the dam, were tried for the first time, and so far with complete success. The water had lately been rising to such a height within the dam as to again alarm some of the people of Marshland, and lead them to predict that, if not their own country, certainly that of the Middle Level itself must be flooded in the ensuing winter. The trial did something to quiet these apprehensions. Of the 15 siphons, each 3½ feet in diameter, six only had as yet been laid down, and it was on these the experiment was made. Mr. Hawkshaw, C.E., Mr. Appold, Mr. Harrison, C.E., Mr. Linn, C.E. (the resident engineer), and other scientific men, were present to conduct and test the operations. The air was exhausted from the tubes by a pump worked by a small steam-engine erected on the bank, and the appearance of water in the pump was the signal to cease working. When the valves at the outer ends of the siphons opened, the water poured over in continuous streams of the full capacity of the outlets, rushing into the outer side of the drain (which now forms a creek from the Ouse) with the noise of a cataract. Of course, the water only continued running during the time when the water level outside was lower than that within the dam—that is, from about half-tide to half-tide; but during this interval so great was the quantity delivered that the level of water within the dam was reduced by nine inches. This result exceeded the most sanguine expectations of the engineers, and from it may be drawn a satisfactory opinion as to what will be the efficiency of the siphons when their number has been increased to 15. In the meantime, those now completed were to be used, not continuously, but only when the accumulation of upland water renders it necessary.

This important subject was fully discussed at the late meeting of the British Association at Cambridge, in October last, when Mr. Thorold read a paper "On the failure of the Middle Level Sluice, and the means of preserving such sluices." Mr. Thorold attributed the failure to the silty nature of the soil being too weak to withstand the great hydrostatic pressure brought against it at

high tides, and he proposed to remedy and secure such sluices from the possibility of failure in future, by the erection of a duplicate sluice at the back of the sea-sluice, for the purpose of keeping up a head of tidal water to a medium height between the two sluices when the sea-sluice was closed by the tide, and he showed by a diagram how this was to be accomplished, avoiding three-fourths of the usual pressure without detracting from the utility of the sea-sluice.

Subsequently, a large party of members made an excursion to Lynn to inspect the works which were being constructed at the Middle Level for repairing the mischief caused by the late disastrous irruption of waters. On arriving at the spot the party were received by Mr. Linn, the resident engineer, who, in conjunction with Mr. Appold, succinctly explained the apparently complicated arrangements. It appeared that the waters were to be carried over a dam full 20 feet high, by means of siphons, which at low water discharged themselves into a canal connected with the sea by means of the river Ouse. The six siphons which had already been laid and tried, were found to answer so satisfactorily that the number was increased to 16. They were of uniform size, 3 ft. 6 in. diameter, 150 ft. long, rising 20 ft. in a curved line, with valves at both ends, and laid in a row 18 in. apart. At the experiment made with the first six siphons it was found that they discharged 50,000 gallons a minute—an immense advantage as well in efficacy as in the saving of expense over the usual appliance of steam-pumping. For this substitution the parties interested were, it was stated, mainly indebted to the ingenuity of Mr. Appold. To set the siphons going, and to pump out the air whenever it interposed, a small steam-engine had been erected, of 10-horse power, working three air-pumps, of 15 in. diameter and 18 in. stroke.

At the close of the discussion, the President of the Section stated that it was very important that investigation should be made into the causes which had been in operation to produce the destruction of these sluices; and he informed the Section that a Committee of the British Association had been appointed to investigate the tidal flow in the estuaries of the Nene and Ouse, having regard to the alterations which have of late years been made in these rivers, and their discharge into the sea.

HYDRAULIC POWER AT THE LIVERPOOL DOCKS.

The Mersey Docks and Harbour Board have agreed to apply Hydraulic Power to the gates at the Wellington half-tide dock, the Huskisson Locks, the Sandon Dock entrance, and the outer storm gates at the two last-named docks, and also to provide two hydraulic capstans on the pier-heads of Sandon-basin, at an estimated cost of 9205*l*. It has been explained that great advantage would result to the working of the trade of these docks by the application of hydraulic power; that the gates by this means could be

opened or closed in three minutes, whereas, by the old system, half an hour was occupied in the performance of this operation; and that after hydraulic power was applied to the gates they could be kept open for the admission of shipping for 20 minutes longer than at present.

COMPRESSING AIR-PUMP.

AT the last meeting of the Manchester Philosophical Society, a paper was read by Dr. J. Joule, entitled, "Notice of a Compressing Air-Pump." The author referred to the difficulties of realizing in practice the theoretical advantages of the air, or the superheated steam-engine. The abrasion which takes place when metal runs against metal, without an intermediate lubricator, speedily destroys the cylinder. He believed that the necessity of using elastic packing would not exist if the length of the channel along which the elastic fluid must pass, in order to arrive at the opposite side of the cylinder, were sufficiently increased. This might be accomplished by increasing the depth of the piston, or by placing on the rim of the piston concentric rings to enter, at the beginning and end of each stroke, corresponding concentric grooves in the covers of the cylinder.

The principle of great depth of piston, as a substitute for packing, had been successfully carried out in the pump which was the subject of this communication. The cylinders, two in number, are twenty inches long and two inches in diameter. The pistons are solid cylinders of iron, ten inches long, fitting as accurately to the cylinders as is consistent with freedom of motion. The depth of each piston, as compared with its diameter, renders the usual guide or parallel motion unnecessary, so that the connected rod is simply jointed at the top of the piston. Air is readily compressed to 16 atmospheres, the quantity passing the sides of the cylinders being very trifling.

Mr. Guibal, professor at the School of Mines at Mons, has applied successfully the compression of water to the detaching of rocks from their beds, and especially to the extraction of coal. At a meeting of the Society, formed by the old pupils of that school, he produced a cast-iron cylinder, divided in two by a partition, parallel to its axis, and presenting the appearance of the shaft of a mine. By the application of the pressure of water, he then broke the two cast-iron hoops which bound the two parts of the cylinder together, and the transverse sections of which presented a surface of 100 square millimètres. By calculation it was found that the pressure applied was equal to 75 atmospheres—a pressure quite sufficient to detach coal, but far within the limit which might if necessary, be obtained.

THE THAMES EMBANKMENT.

THIS great work has been commenced. The total length of the Embankment proper is to be a little over 6000 feet. Its width

will vary at different parts from 200 feet at Temple-gardens to 450 feet at Hungerford-bridge. Along its whole length will be one noble roadway of 70 feet wide and two footways of 15 feet wide each. Only on the east side of Temple-gardens will the dimensions of this fine avenue be reduced to a total width of 70 feet —namely, 50 feet for road and 10 feet for each of the footways. The height of the road above high-water level will average about four feet, till the incline commences by which it is carried up on arches till it debouches into Bridge-street, Blackfriars, at Chatham-place, and there for the present ends. The height of the granite parapet protecting the roadway will be four feet, and viewed from the river at low water, it will appear as a magnificent quay of solid masonry, some 26 feet high, and more than a mile and a half in length.

The face of the embankment will commence at the northern abutment of New Westminster-bridge, in a line with the water front of the Houses of Parliament, and it will extend in a slightly curved line to the northern brick pier of Hungerford-bridge. At Richmond-terrace it will be 220 feet in front of the present high-water line, at Scotland-yard 400 feet, and at Hungerford-bridge 300 feet. From Hungerford-bridge it will continue to the first Middlesex pier of Waterloo-bridge, and opposite Buckingham-street it will extend no less than 450 feet into the river; opposite Salisbury-street, 300 feet; and opposite Somerset-house, 130 feet. The solid embankment is to terminate on the eastern side of Temple-gardens, where it will extend about 200 feet into the river. From the junction at Westminster-bridge it will descend at an inclination of 1 in 80 to the mean level of the bank above high-water mark. From the east end of the Temple-gardens the ascent to Chatham-place is to be 1 in 60, and from this point, it will be taken on wrought-iron arches of exceedingly handsome design, carried on similarly ornamental cast-iron columns, so as to allow a waterway under the road to the London Gasworks and old Whitefriars docks.

According to the dimensions which we have given as to the width of the various parts of the work, it will be seen that a total area of no less than 34 acres will be reclaimed from the bed of the river, and no less than 12 are to be laid out with trees and flowers. Near Hungerford will be quite a little park, larger in its area than the Temple-gardens. There will be another quite as large between Hungerford and Waterloo. The Templars will get a strip of grass land 800 feet long by 120 wide, which they will add on to the length of their pleasant gardens. All the private houses facing the river between Westminster and Whitehall get additional garden land between them and the embankment—in some cases as much as 180 feet, and none less than 100.—*Times, Nov.* 27.

NEW BRIDGE AT TWERTON.

A BOWSTRING Girder-bridge has been erected across the river at Twerton. It is said to be built on a new principle, invented

PORTLAND BREAKWATER.

A VERY interesting account of this stupendous work has appeared in the *Times*. The writer says :—Viewed from the shore beneath the steep bold headlands of Portland Bill, the long thin stony reef which stretches out in a tapering line into the sea till it would be almost lost to view, but for the mass of black scaffolding which surmounts it, has nothing just now very imposing in its appearance. It does not appeal to the senses, and has little to point out to the superficial eye where thousands and thousands have laboured daily for the last fourteen years. The fruits of all these years of toil lie deep beneath the sea, never to be seen again. If the waves were away, what a monument of persevering ingenuity and labour would they not lay bare! The divers employed see it all, and know that the thin reef above the water represents a wall of stone beneath, to which that of China is mere plasterers' work; a wall of stone nearly a mile and a-half long, nearly 100 feet high, and 300 feet thick at the base, and all raised beneath the sea. To make this wall, nearly six million tons of stone have been consumed, and nearly a million cubic feet of timber required for scaffolding. The mass of stone alone, if built in a solid column 100 feet in diameter, would reach to the summit of Mont Blanc! One, in fact, is almost at a loss for standards of comparison before the immensity of this work, the materials for which were heaped in at the rate of 2500 tons a day, and sometimes at 3000. It is only by looking at the results it has achieved that we begin to understand the greatness and importance of what is effected by this submarine mountain. Portland Harbour was always a safe shelter against south-west, north-west, or northerly winds. It was exposed on the east and south, and a mere open roadstead to the strong gales which blew from the south-east. The Breakwater was designed by sheltering it here to shelter it from all points, and this it has most effectually done. The harbour, now almost enclosed by this stupendous sea-wall, has at low water an extent of no less than 2100 acres. Taking three fathoms' depth as the standard at low water, the acreage of our made harbours is as follows :—

Kingston	140
Holyhead	267
Dover (when made)	374
Portland	1590
Plymouth	1741

The average of deep shallow water is, however, greater at Portland than at Plymouth, there being 1290 acres varying in depth from 5 to 11 fathoms. The breakwater itself is built in two distinct parts, in the shape of an obtuse angle. It stretches from what we may call the island of Portland, for a length of about 3500 feet towards the north-east, and then for a length of nearly 5000 feet more turns due north into deep water across the bay. The break of the two parts occurs at the east end, and just before the angle of turning north. This opening is made in order that ships going out in a northerly wind may not have to beat up the whole length of the breakwater, but pass at once through the opening into smooth water, and take a fair wind down Channel.

WELL-SINKING AND BORING.

In a future page will be found a paper read and discussed at the Society of Arts, "On some recently-executed deep Wells and Borings," in which much valuable information is given as to works at a distance, in France and parts of England. A well and boring is now on hand at the head of the Serpentine, Hyde-park. A well has also been sunk and bored at Kensington, to supply water for the Royal Horticultural Gardens. We give the facts connected with this striking work. The contractors for the new well at Kensington are Messrs. Easton, Amos, and Sons. Mr. Tilly, of Enfield, has performed the work of sinking and boring.

Stratifications passed through.

Feet.		Feet.
18.	Made ground	18
22.	Loamy gravel; little water	40
198.	Hard blue clay; "London clay"	238
54.	Pebbles, sand, and water	292
20.	Green sand and water	312
4.	Live grey sand and water	316
1.	Flints, surface of chalk	317
84.	Chalk, beds of flints, and water	401
401 feet vertical.		

The well is 5 feet clear in diameter; and has 9-inch brickwork in cement, from the surface to a depth of 200 feet, vertical. The bore-hole is 201 feet deep from bottom of well. Water rises to within 130 feet of surface, or to some 70 feet deep in shaft. The pumps, lifting water at a rate of 100 gallons per minute, only reduce the head some 18 inches, and this speedily rises to its level when pumping ceases: 100 gallons per minute are equivalent to 144,000 gallons each day. The water, in quality, is pronounced "excellent:" it is, in fact, chalk spring-water.

At 312 feet in depth the water from the green sand was not so abundant, but stood at 20 feet higher level than at present. The chalk, therefore, though containing more water, must have a lower general level than the water in the green sand.

The contractors have fitted up some beautiful pumping machinery, both for the deep lift from the well and for garden fountains and cascades. The tall chimney is, however, an ugly structure. After Mr. Rawlinson's work on "Tall Chimneys," it seemed less likely that we should find the old, plain, tapering furnace shaft amidst the ornamental work of the Royal Horticultural Gardens. We quote these notes from the *Builder;* and must add, that most of the ornamental work in the Horticultural Society's gardens is pretentious, but of poor character, like its grand neighbour.

NEW WESTMINSTER BRIDGE.

SATURDAY, May 24th, witnessed the completion and opening of New Westminster-bridge, one of the most important metropolitan improvements that have been executed in our time. The opening was fixed for Her Majesty's birthday, May 24th, a quarter to 4 o'clock, the precise time when Her Majesty was born, and at that hour a salute of 25 guns—a number corresponding to the years of her reign—was fired, the barriers were removed, and the whole extent of the noble roadway of the bridge left open to public traffic. The works were commenced by Mr. Page in the middle of 1859. It was necessary in every case to disturb the old piers, though always dangerous and crumbling to decay—sometimes even to cut them in half under water, and shore up the remainder as well as could be effected till the pier for the western half of the new structure was placed. No cofferdams were used, and the manner in which the employment of these most expensive auxiliaries was avoided may be plainly told in a very few words. On the site of the pier, elm-piles were driven deep below the bed of the river into the London clay. Round these again were forced massive iron circular piles, grooved at the edges, so as to admit of great sheets of cast iron being slid down like shutters between them. When these shutters, if we may so term them, had been fixed and closed by drivers, the space they shut in was carefully dredged out of mud down to the bed of the river, the piles tied together with iron rods, and the space filled in between with concrete up to low-water mark, when the masonry—enormous slabs of granite, weighing from eight to twelve tons—was fixed for the pier, and on these were raised the massive stone piers themselves. The arches of the bridge are seven in number, each formed of seven ribs, which are of cast-iron nearly up to the crown, where, to avoid danger from the concussion of heavy loads, they are of wrought metal. The arches vary in span, from the smallest, of 96ft., to the largest in the centre, of 120 ft., and from a height above high-water level of from 16 ft. to 20 ft. The materials used in the construction of the whole bridge have been 4200 tons of cast and 1400 tons of wrought-iron, 30,000 cubic yards of concrete, 21,000 cubic yards of brickwork set in Portland cement, 165,000 cubic feet of granite, and 46,000 cubic feet of timber. Its gradient is

12 ft. lower than the old bridge, and its total width more than double, so that while it lays claim to the honour, which few will deny it, of being the handsomest bridge over the Thames, it is also, size for size, by far the cheapest that has yet been built, costing per superficial foot less than half the price of any similar structure in London. The length, breadth, and cost of each of the metropolitan bridges have been as follows:—

	Length. Feet.		Breadth. Ft. in.		Cost per Square ft.
London	904	...	53 6	...	11 6 0
Southwark	800	...	42 6	...	11 5 10
Blackfriars	994	...	42 0	...	3 15 6
Waterloo	1380	...	41 6	...	10 0 0
Hungerford	1536	...	13 4	...	4 16 6
Westminster, old	1160	...	43 0	...	7 16 0
Westminster, new	990	...	85 0	...	4 0 0
Vauxhall	840	...	36 2	...	9 16 0
Chelsea	922	...	40 0	...	2 5 0
Proposed new bridge at Blackfriars	980	...	76 0	...	3 5 0

Thus it will be seen that the new bridge is very nearly twice as wide as any of the bridges over the Thames. Within the parapets it is 84 ft. 2 in. Of this the footways occupy 28 ft., the road for the light traffic 39 ft., the tramways 14 ft. 8 in., and the space between them 2 ft. 6 in. The tramways consist of iron-plates, bolted to timbers, and laid upon an elastic bed of cork and bitumen. The kerb of the footway is formed of Ross of Mull granite; the footway itself is of Blachfield's terra cotta. It inclines towards the parapet with a fall of 1½ inch, and a gutter on each side carries off the water. The value of this material for paving purposes may be estimated by the fact that when rubbed with sand and water against Yorkshire stone, the stone loses twice as much as the terra cotta. This pavement is laid in diamond-shaped tiles, which are grooved across transversely, so as to give the firmest foothold.—*Abridged from the Times.*

LAMBETH SUSPENSION BRIDGE.

On November 10th, the new Suspension Bridge at Lambeth, the latest and one of the most needed of our many recent great metropolitan improvements, was thrown open to the public. It has been built by a public company, Mr. Barlow, the engineer, undertaking the whole structure from shore to shore should be completed for 30,000*l*. This estimate for a foot and carriage traffic bridge across the Thames was regarded at the time as almost ridiculous. The cheapest bridge ever built across the river had not cost less than 3*l*. per superficial foot—the majority have cost nearly 10*l*.—but here was an offer to build one at less than a pound a foot. The company has let the tolls for three years at the rate of 10 per cent. upon their capital. This is high interest, but higher still is looked for, as after the first three years the tolls, it is calculated, after the completion of the Thames embankment, ought to let at a sum yielding 20 per cent. per annum on the whole capital.

Lambeth New Suspension Bridge has a total length over all of 1040 feet, and a length between the abutments on shore at either side of 828 feet. Its extreme width is 32 feet, which is divided into 20 feet for roadway, and six feet for each of the footpaths, and its total height above high-water mark is 21 feet clear. The rise or curve of the structure is 1 in 22 feet on the bridge itself, and 1 in 20 feet on the approaches. For such a steep rise the bridge itself should have given a greater headway than 21 feet, but this would have involved heavy outlay in raising the approaches at either end, and, of course, could not be attempted in a structure the total cost of all connected with which, even to painting and roads to it, was not to exceed 40,000*l*. The suspension ropes are taken over four pairs of towers, two of which at either end rest on the abutments of solid masonry, and two are upon circular piers in the bed of the river. Over these towers the suspension ropes are carried, sustaining the bridge beneath in three spans of 280 feet in length each. These towers, though they look exceedingly light, are stated to be as many as seven times stronger than any strain they can ever be called upon to bear, even supposing the road and footway of the structure to be densely packed with a crowd of people. Each tower is of boiler-plate ¼-in. thick, strengthened with 2½-in. angle iron, and built upon the cellular principle adopted in the Britannia-bridge and in the double sides of the *Great Eastern*. The sectional area of these towers gives 120 square inches of iron, and the utmost weight, it is said, which can come upon them when the bridge is fully weighted to its load strain is only 2½ tons per inch,—just half the strain which the Britannia-bridge, on the same principle, has always to carry, and only, we believe, about one-third of the strain upon the great Victoria-bridge at Montreal. At the abutments, as we have said, two of these towers rest on masonry of the most solid description. On the river-piers they are fixed on circular cast-iron cylinders, which are taken down 18 feet below the bed of the river and into the London clay. These cylinders are 12 feet diameter and 1¼ inch thick, and the mode of fixing them was, though on a very small and easy scale, much the same as that pursued with the very difficult foundations of the piers of Mr. Brunel's great bridge at Saltash. The cylinders were lowered into the places they were to occupy and forced down below the bed of the river. The water and mud were then dredged out, and the cylinder filled to a depth of nine feet with solid concrete, then three feet of solid brickwork, finishing with a brick invert arch, and thence a lining of three feet of solid brickwork up to the top of the cylinder on which the tower rests. This lining of brickwork, therefore, leaves a circular opening six feet wide in the cylinder down to the bed of the river, so that the work can be examined, if necessary, to its very foundations from time to time.

The ropes by which the bridge proper is suspended are of the best charcoal iron wire, and were made by Newall and Co. on the works of the bridge itself. There are two of these main ropes on each side, each being made up of seven massive ropes banded together, and each of these seven ropes containing seven strands of wire, two-tenths of an inch in diameter. The sectional area of each main rope is 100 square inches, and their united strength is guaranteed to bear a strain of 4000 tons, and in detail has been proved to that amount, though the greatest strain that can come upon the bridge is only estimated at 600 tons with ordinary traffic. These ropes are secured at either end round what may be termed a massive eye-bolt, with 28 screw-bolt fastenings, each fastening having already been-tested with a strain of 82 tons. The "anchorage" in which all are finally secured on both sides of the river is, on the Lambeth shore, where the ground is good, formed by massive iron holdfasts or beams, built into a solid masonry of concrete 20 feet below the surface. On the Westminster side, where the ground is little better than loose peat, the anchorage is made by a series of 12 square cast-iron caissons, each weighing

seven tons, sunk into the gravel, and filled with concrete, and the square space thus enclosed by the whole twelve dug out and filled with concrete, so as to form one immense compact bed of iron and concrete 20 feet below the surface. Thus far, therefore, the ends of the ropes are as firmly secured as if they were taken down to the centre of gravity itself. It only remains to be seen how, in this situation, the wire will resist the attacks of its great destroyer, rust. The want of efficient precautions against this apparently insignificant item of wear and tear has brought many wire-rope bridges to a premature end. From the wire-ropes so secured come down a regular series of lattice tie rod uprights, with diagonal bracings on each side, at an angle from the roadway of 45 degrees. Beyond that these latter are placed closer than we have ever seen them before, and of greater strength, there is not much in what we have described that differs in principle from other suspension-bridges. The roadway is usually then hung to the ropes and tie rods, and there is an end of the work. In Mr. Barlow's bridge, however, a new principle is introduced, which almost, if not quite, does away with the lateral and vertical motion so dangerous to ordinary suspension-bridges, and which has rendered some in this country and many in America almost useless for heavy traffic. This consists of taking under the floor of the bridge what may be called two powerful longitudinal box girders, one on each side. The sectional area of each of these is 40 inches, and each is 2 feet 3 inches deep by 18 inches wide. These diminish any upward or downward movement to a *minimum*, and absolutely check all lateral swing. To these girders, which are, in fact, the backbone of the whole structure, the lattice tie rods we have described are fastened, and thus such rigidity is given that, calculating according to the strain wrought-iron ought to bear per inch, it is said that the whole floor of the bridge, if laid sideways, would even then be strong enough for its traffic.—*Abridged from the Times.*

NEW BRIDGES AT BLACKFRIARS.

MR. PAGE'S designs, which had been accepted, have been rejected by the Common Council overruling the Bridge-house Committee. This time it is Mr. Cubitt's design which has been chosen, and we are assured that this decision is final. Much of the delay, it is said, has been caused by the fact that alongside the new City bridge at Blackfriars the railway bridge of the London, Chatham, and Dover Company was also to be erected.

New Blackfriars-bridge, to be built by Mr. Cubitt, is to be five-arched, of mixed stone and wrought-iron, and, while its gradient on either side will be reduced to a slope less than half that of the present structure, the headway or space between high-water mark and the crowns of the arches will be quite as great, the increased strength of the wrought-iron ribs not necessitating their being of such a depth. The site of the new bridge will be exactly that which the old one now occupies, allowing, of

course, for the difference of increased space which the larger dimensions of the new one will require. Its length is to be 963 ft., and its width for traffic 75 ft. This latter space is to be divided into one roadway 45 ft. wide (wider than the entire width of the present bridge) and two footways of 15 ft. each. Of the five arches the centre is to have a span of 189 ft., the two arches on either side of this a span of 176 ft., and the shore arches at either end a span of 167 ft. each. The clear headway between high-water mark and the crown of the centre arch will be 27 ft., the springing of the arches commencing about 18 ft. above the water. The whole structure will be about 5 ft. lower than the present bridge.

The piers are to be of solid masonry, taken down into the London clay no less than 40 feet below high-water mark. These, by means of iron caissons, can be built without resorting to the cumbrous and expensive system of coffer-dams. The caissons will be sunk on the exact spot to be occupied by the masonry of the pier, and forced down by pressure into the bed of the river. The water will then be pumped out, and the mud and gravel at the bottom dredged away, and as the dredging progresses the caissons will be forced deeper and deeper, till the ultimate site of the foundations on the London clay is deeply penetrated. Here the masonry will be laid in immense blocks of granite, which will be bolted together and continued to the point above high-water mark where the springing of the arches commences. The arches are to be formed of ribs of wrought-iron, light in appearance, but, of course, of immense strength. Each arch will be composed of ten of these ribs, each rib being placed at intervals of about 6½ feet apart. They are to be connected together by cross girders and covered in above with an iron floor. On this floor will be placed a thick layer of asphalte, and over all the light granite roadway pavement known as "stone pitching." The spandrils of the outer iron ribs on the east and west sides will be filled in with wrought-iron scroll work, and the whole surmounted with a handsome iron cornice and balustrade. Above the five stone piers we have spoken of, red granite columns will be placed so as to screen the junction of the wrought-iron ribs behind them. These granite columns, which are to be highly polished, will be nearly 7 feet in diameter, and 18 feet high, with handsome pediments and capitals, the latter surmounted with richly carved recesses in white stone. The cost of the bridge, including the temporary wooden bridge for the traffic while the new one is building, is to be 263,000*l.*, and the whole is to be completed in from two and a-half to three years.

The Railway Bridge is hereafter to form, with that at Charing-cross and that at Chelsea, the great main avenues of communication between the lines north and south of the Thames. The size and position of its piers will exactly correspond with those for the City bridge, and (as the end of the cutwaters will only be 25 ft. distant) it is proposed to connect the two together by a slight line of masonry or iron casing. This railway bridge, of course, is taken at an uniform level across the Thames, leaving a clear straight headway between the openings (which, like the piers, correspond in width with those of the City bridge) of more than 29 ft. from high water, making it on the whole 2 ft. higher than the highest part of new Blackfriars. On each pier will be placed three groups of cast-iron columns—one in the centre and one at each end; each group consisting of four columns braced together, and each column 6 ft. in diameter and 18 ft. high. Resting on these groups of columns will be very powerful flat

wrought-iron lattice girders, the outermost ones on the east and west sides, like the outermost ribs of the bridge, being filled in with ornamental brackets and scroll iron-work. This bridge is to be laid for four lines of rails, to run into the new station on the site of the old Fleet Prison, whence, by the Subterranean Railway, the communication will be direct with the King's-cross and Great Western lines.—*Abridged from the Times.*

THE FOUNTAINS IN TRAFALGAR-SQUARE.

THESE fountains, which it has been *ab initio* the fashion to abuse, without making due allowance for the cause—the parsimony of the vote for their erection—have lately been improved. "To the present time the fountains in Trafalgar-square consisted only of a single jet falling over from an upper and lower basin. This still remains as the centre figure of the basins, but at each of the semicircular bays there is now a group of jets, consisting of a centre and sixteen surrounding it. The jet of water from the centre rises about 5 feet, and those in the outside 4 feet. There are, therefore, in the first instance, 68 jets, throwing 300 gallons per minute, rising from the surface of the basin. The ground plan of the basins is a square, the sides of which are about 68 feet long, and semicircular bays project from each of these sides. In the latter, as we have stated, are the circular groups of jets. An outline of an octagon is formed within the square, and at each of the angles is a jet which throws the water inwards to a height of 20 feet, and into the upper basin of the central fountain. These eight jets throw 200 gallons per minute, and their curve is about 30 feet in length. There are, again, two inferior squares surrounding the central group, and from each of the angles a jet is thrown outwards, crossing these from the octagon, rising to the height of 25 feet, and curving about 17 feet. These throw altogether 200 gallons per minute. Beyond the sides of these smaller squares are eight feather jets, which throw up 200 gallons per minute, each of the groups of jets forming a display resembling the Prince of Wales' feathers. The whole of these may be played at once or together, in not less than twenty-five different continuations or changes."—*Observer.*

METROPOLITAN MAIN DRAINAGE.—THE NORTHERN OUTFALL SEWER.

THIS great engineering work, estimated to cost nearly three-quarters of a million of money, and in the construction of which some three years will have been spent, has been submitted to the inspection of the council and members of the Institute of Civil Engineers, and several military and scientific men of eminence, on the invitation of Mr. Bazalgette, the engineer to the Metropolitan Board of Works.

Starting at Old Ford, a point where the high and middle level, two of the three great lines of sewers which are to drain the

whole of the northern portion of the metropolis, converge, this northern outfall sewer goes on to Barking, a distance of about five and a half miles, crossing the main River Lea and five of its branches, the East London Waterworks feeder, and (by a tunnel) the Eastern Counties Railway, the top of the brickwork of the arch of the sewer being on a level with the under side of the railway. It then crosses in succession the Stratford-road and the North Woolwich and Southend lines of railway, and proceeds thence, through West and East Ham and Plaistow, to the Thames, near Barking-creek. From the River Lea the high and middle level lines of sewers proceed side by side for about a mile; then, joined by the low level, all three run parallel for the remaining distance to the point of outfall. At Abbey-mills a pumping-station will be erected for lifting the sewage of the low level line to the level of the other two, a height of some 35 feet. The whole of this northern outfall sewer, running in these three parallel lines, is above the surface of the ground at an average height of 20 feet. For the greater part of its length it is bedded on a solid bank of concrete, averaging 12 feet in depth and 50 feet in width. The portion nearer the outlet, for a mile and a half over a piece of marshy land, is carried upon a substructure of concrete piers, with brick arches. The Lea and its tributaries are crossed by means of iron aqueducts or tubular bridges. The brickwork of the line, throughout its entire length of five miles, will be covered by an earthen embankment, 40 feet wide at the top, with sloping sides. This it is in contemplation to use as a roadway, and probably in course of time dwelling-houses will be built on either side of it. In size each of the three lines of sewers is 9 feet high by 9 feet wide, having a semi-arch at the top, segmental sides, and an invert, and presenting to the eye when seen in a cross section three tunnels, running side by side. The discharge into the Thames will take place regularly at two hours after high water. Great reservoirs will be constructed near the place of outlet, in which the sewage from the three lines will accumulate from four hours after high water until two hours after the following flood tide. These reservoirs, all of which will be covered over, will empty themselves in two hours, and ordinarily the sewage from them will be conveyed by culverts to the level of low-water mark.

The whole cost of the Northern Outfall Sewer is estimated at about 625,000*l.* It will probably be finished towads the end of the year 1863. It is hardly necessary to state that it is being carried out by the Metropolitan Board of Works, as part of the grand intercepting scheme of sewerage in course of progress for draining London on both sides of the Thames designed by Mr. Bazalgette, their engineer. The contractor is Mr. George Furness, the resident engineer being Mr. Edmund Cooper. As matters of curiosity, it may be stated that about 500,000 yards of concrete will be used in the work, 20,000 rods of brickwork, 800,000 bushels of cement, and 100,000,000 of bricks. Tramways are

laid along the whole line of the work for conveying the materials to be used in its construction; five locomotive engines are constantly in use, and 500 trucks, while employment is given to about 2300 men, forming the contractor's staff. Dotted here and there along the line are mills for making concrete, one of them turning out as much as 360 yards of concrete a day. The whole line has an average fall of two feet in a mile. All the brickwork is laid with Portland cement, in the proportion of three of sand to two of cement. Within a quarter of a mile westward of the Lea, at a point where the high and middle level lines of sewers meet, an overflow chamber, which is intended to play an important part in the scheme, has been erected. This chamber is constructed with what are called weir walls, for the purpose of allowing the sewage water, when surcharged with heavy rainfalls, after reaching a certain height, to overflow and discharge the superabundant mass, which might otherwise burst the sewers, into the River Lea. It answers, in fact, the purposes of a safety valve, and will always prevent the sewers running under pressure. The northern high level line, about nine miles in length, commencing at Hampstead, and draining in its course the districts of Highgate, Holloway, Stoke Newington, Hackney, and Bow, is entirely completed, and in use. The middle level line, extending from Bayswater to Old Ford, and draining all the intervening country, is now in the course of construction by Messrs. Brassey, at a cost of about 300,000*l.*—*Times.*

THE MACHINE FOR TUNNELLING THE ALPS.

THIS very ingenious piece of mechanism has been completed by the firm of Hawks, Crawshay, and Co., and tested at the Claxton Quarry, on the Sunderland-road. This machine was originally intended to be employed in undermining Sebastopol. The engine for propelling the cutting machine resembles a locomotive engine, and is mounted on very low wheels. It has no funnel on the top, probably on account of the limited height of the tunnel, but the steam will be emitted at one end. The cutting machine, to which the engine will be attached, resembles a large wheel, and a double row of knives or teeth, of the finest steel, are arranged on what may be termed the spokes of this immense wheel. The knives of the machine are placed against the rock intended to be cut, and the wheel revolves and is pressed forward at the same time against the rock, cutting a large circular hole. A series of iron rakes are also attached to the machine, for removing the fragments of the rock cut out by the knives. New machines for cutting the great tunnel through the Alps were successfully tried at Modane some time ago; and the machine manufactured by Hawks, Crawshay, and Co., it is believed, will be employed in the same great undertaking. The length of the tunnel already cut is 1680 mètres, of which 783 are on the French side and 950 on the Italian side.—*Builder.*

VENTILATING FANS.

MR. ATKINSON has stated to the Northern Institute of Mining Engineers, that he has been trying some experiments with a Fan of peculiar construction at Tursdale Colliery, near Durham, and gave some of the results arrived at. Mr. Atkinson also gave some account and description of the fan used by the Pneumatic Dispatch Company in London, by which 14 inches of water pressure could be obtained. The principle appeared to him to be capable of being applied to the ventilation of mines with advantage. The fan consisted of two discs, and was about 20 feet in diameter, and made above 200 revolutions per minute. It was constructed so as to allow of this velocity being obtained, whilst the Elsecar fan could not with safety be driven above 70 revolutions per minute. By the Pneumatic Company's fan he obtained 30,000 cubic feet per minute through an opening of six square feet. The president stated that at first the company had considered it necessary to have the piston in the tube quite tight; they now, however, found that this was not necessary, and that little loss was caused by a space being left all round the piston. This materially reduced the friction.—*Mechanics' Magazine.*

ORIGIN OF PETROLEUM.

THE flow of oil from mineral springs is by no means new either to science or commerce. Herodotus has recorded that the island of Zante furnished large quantities, while Pliny and Dioscorides describe the oil obtained from Agrigentum, a small town in Sicily. The Persian springs at Bakoum have yielded to the value of 600,000 dols. annually; and the earth oil from Rangoon, in Burmah, has been exported to the extent of 400,000 hogsheads yearly. The streets of Genoa and Amiens were formerly lit by a Petroleum obtained from Parma. In 1847, a spring was discovered in Yorkshire, which was successfully worked by Mr. James Young, of Glasgow, until exhausted, when he turned his attention to the distillation of coal, and discovered paraffine oil. The marvellous oil-springs of the New World, however, far surpass in extent and interest all previous discoveries, and the quantity already yielded, without apparently diminishing the supply, shows that this will be a most important article of commerce for some years to come. In Canada the oil rises from the saturated corniferous limestones; in the States it is principally obtained from Devonian sandstones, while in Western Virginia and Ohio it rises directly from the coal measures. In all cases it, no doubt, arises from the decomposition of coal by temperature and pressure, and is lifted by the percolation of water under it to cavities and fissures in rocks till it approaches the surface, and it is generally accompanied by quantities of coal gas.—*Dr. J. B. Edwards.*

DANGEROUS LAMP-OILS.

IN a letter addressed to the *Times* by "A Manufacturer," we find the following particulars of the oil bearing the name of

"Paraffine Oil," and the respects in which it differs from the genuine paraffine oil.

The well-informed writer states that these economical oils have for many years been very extensively used in Scotland and many parts of the Continent, and have there gained an established reputation for being a safe, cheap, and convenient source of light. And he is of opinion that, as regards the oils which have hitherto been used, there are no grounds for any apprehension of danger.

But, having recently had occasion to inquire into the characters and history of the hydrocarbon oils at present in the market, he has learnt with great astonishment that an immense quantity of such oil is now being sold under a great variety of names, which is totally unfit for being burnt in lamps with safety.

The danger attending the use of explosive or inflammable oil in lamps is great, and the use of these several oils is extending rapidly among all classes. In addition to the purity of hydrocarbon oil, which determines the brilliancy of the light it gives, the most important character, as regards safety, is that the oil should be incapable of burning without the aid of a wick—that when a light is brought into contact with the surface of the oil it should not take fire and blaze up as spirit of wine would do. It is with this limitation only that the term "non-inflammable" can be applied to hydrocarbon oils; but it is nevertheless a limitation of very considerable importance, as indicating the point on one or other side of which these oils may or may not be used with safety for burning in lamps.

The fitness of any material for the production of lamp-oil will depend on its relative yield of oil possessing limited volatility, in proportion to those oils which, on the one hand, will not burn without smoking, and on the other are too volatile to be burnt with safety.

Among all the materials from which hydrocarbon oils are now manufactured, the American earth-oil is pre-eminent in yielding what may be termed supervolatile oil in such very much larger proportion than the oil of medium volatility that it probably would be impossible to use this material for manufacturing lamp-oil having the character above described as proper to it. However, this fact, obvious as it is, has not prevented the attempt to introduce as lamp oil the highly volatile product of the American petroleum. The oils already referred to as being unsafe are chiefly from this source. As generally met with, they are quite or nearly colourless; presenting a beautiful appearance, which might lead many to regard them as of very superior quality, and from this specious advantage over other hydrocarbon oils, as well as the vigour with which they are being pushed into notice, they may come to be largely used, and also to influence very prejudicially the manufacture of other oils of this kind.

The following is the mode of applying the test of the oil:—

About a thimbleful to be tried should be poured into an inverted pomatum-

pot lid, or a small saucer, and a splint, or thin piece of dry firewood, lighted at the end, dipped into the oil so as to let the flame of the wood continue burning while it is stirred about in the oil for at least one minute, when a perceptible vapour will begin to rise from the oil, owing to its being slightly heated by the burning wood. An oil that is perfectly safe to burn in lamps will not take fire when subjected to this test within the time stated; but many samples tried in this way, and all of those that were known to be made from American petroleum, took fire the instant the light was put to them, others within from two or three seconds to half a minute, the latter being oils containing admixtures of supervolatile oil, or from which the supervolatile portions had not been properly separated. Some samples, again, did not take fire until the flame had been in contact with them for full three minutes, and the oil had become quite hot.

COAL-TAR.

COAL-TAR is a very complicated body, and, when carefully distilled, it yields certain volatile fluids, smelling more or less of tar, among which is a naphtha called "benzole." Small bottles of benzole are sold for removing grease stains under the name of *benzine collas*. Benzole is next acted on by nitric acid, and by that means changed into nitro-benzole—a liquid having so exactly the smell of the essential oil of bitter almonds that it is substituted for it in the manufacture of almond soaps and of cheap perfumery. When iron filings and acetic acid act upon the nitric benzole it is changed into aniline, and this aniline when acted on by arsenic acid, bichromate of potassium, permanganic acid, stannic chloride, &c., yields a great variety of very beautiful colours. These coal-tar dyes were a characteristic feature of the Exhibition. In Perkin's case was shown a cylinder of solid aniline purple, which could easily be carried under the arm. It is worth at least 800*l.*, and required for its production the tar obtained from 2000 tons of coal. It is in tinctorial potentiality equal to 100 miles of calico.

LABUAN COAL.

THE Labuan Coal Company have issued a circular containing an analysis of specimens of their coal made by Dr. Percy, of the Government Museum of Geology. The first specimen is pronounced to be very valuable and superior to the best coal of South Staffordshire, from the fact that it contains more hydrogen and less water. The second specimen was one sent home by the manager, Mr. Sinclair, and on this the judgment is equally favourable. It burns with a copious bright flame, is a non-caking coal, and has the great advantage of containing only a small proportion of sulphur. It has likewise peculiarities that specially adapt it for seagoing vessels, and also for the manufacture of gas, as well as for use in the various metallurgical operations in which a copious flame is required, as in reverberatory furnaces. The quantity available appears to be virtually inexhaustible, requiring nothing but a good supply of labour for its extraction. A Singapore Gas Company has recently been established, to which it is likely to afford important facilities.—*Times.*

UTILIZATION OF WASTE HEAT.

An invention has been patented by Mr. J. S. Joseph, of Rhostyllan, North Wales. It consists in constructing a large retort built up of fire-brick or other suitable material, and surrounded by an outer shell of the same, so that a space may be left all round the retorts, the ends of the latter passing through the ends of the enclosing structure, and being provided with suitable doors. In order to support the retort, he forms piers of fire-brick or other suitable material underneath the same. This retort oven he employs either for making coke, charcoal, or for any other similar processes. At or near the top of the retort he forms suitable openings, through which the combustible gases formed inside the same, by any of the above-mentioned processes, pass into the surrounding space. He introduces small jets of atmospheric air, and thus causes the complete combustion of the combustible gases, thereby creating an intense heat. The hot products of this combustion by preference he employs for generating steam, making illuminating gas, firing pottery, heating drying-stoves for general purposes, for calcining ores, for burning bricks, or for burning lime in kilns.—*Builder*.

GAS GLASS-HOUSE FURNACES.

Professor Faraday has read to the Royal Institution a paper on this subject. He commences by describing, with nearly the wonted enthusiasm of former days, the glowing intensity of the mass of flame in a Glass Furnace, which resembles the body of the sun, though on closer inspection it is seen to be composed of innumerable tongues of flame. The immense mass of heat thus produced, the great cleanliness of such a furnace compared with those in which incandescent solid fuel is consumed, and the facility with which it is managed by a single man, were noticed as important improvements in the construction and management of glass furnaces. It is not, however, by the combustion of ordinary coal-gas that these effects are produced. Solid fuel is in effect employed, but the gases evolved during an early stage of its combustion are consumed with an additional supply of oxygen in that part of the furnace where the work is done. Professor Faraday said the subject had been impressed on his mind during a recent visit to Birmingham, by the inspection of Mr. Siemen's regenerative gas furnace, where he had witnessed the processes of glass manufacture carried on with a facility, cleanliness, and completeness that were astonishing. A large diagram representing the construction of the furnace was exhibited, from which it appeared that the solid fuel was allowed to descend an incline to the hearth, composed of fire-bricks, where it was gradually consumed; about two or three feet thick of fuel being kept burning. The gases evolved rise through the descending coal, and a large portion become converted into carbonic oxide, and the gases are then conducted into

the chambers of the furnace, and a supply of air being admitted, they are burned with great effect and with little waste of heat. There is, indeed, so little waste of heat in these furnaces, that the temperature at the chimney-top does not exceed 300 degrees of Fahrenheit, the economy of heat being effected by the "regenerative" arrangement, by which means the heat of the flame is first applied to heat the fire-brick air-passages, and in the latter the admitted air becomes highly heated before it inflames the gas, on the same principle as a respirator, which having become heated by the breath exhaled, afterwards imparts heat to the air that is inhaled. Assuming 4000 degrees of heat to be generated by the perfect combustion of carbon, it is calculated that by the regenerative process 3000 degrees of heat are returned. In the furnace described there were four fire-chambers, containing eight pots of melted glass each, and one pot holds about two tons of molten glass. The pots are not closed, as is necessary in ordinary glass furnaces, to exclude ashes and dirt, for the furnaces heated with gas are free from such impurities, and great facility is thus given for working the glass, the quality of which is also greatly improved by the greater command which the workmen possess of regulating the heat. In the conclusion of his lecture, Professor Faraday alluded, in an affecting manner, to his increasing loss of memory. There was a time, he observed, when he inclined to think that memory was a faculty of secondary order; but he now feels its great importance; and the deficiency of that power, he said, would prevent him from again bringing before them anything that was new, for he was often unable to recollect even his own previous researches, and he could no longer trust himself to lecture without notes.

IGNITING POINT OF COAL-GAS.

Dr. Frankland has experimented on this subject, and the results arrived at are thus summed up:—1. Coal-gas cannot, even under the most favourable circumstances, be inflamed at a temperature below that necessary to render iron very perceptibly red-hot by daylight in a well-lighted room. But this temperature is considerably below a red heat visible in the open air on a dull day. 2. This high Igniting Point of Coal-gas, under all circumstances, is due in a great measure to the presence of olefiant gas and luminiferous hydro-carbons. 3. The igniting point of explosive mixtures of the gas of coal-mines is far higher than that of similar mixtures of coal-gas; consequently, degrees of heat, which are perfectly safe in coal-mines, may ignite coal-gas; hence, also, the safety-lamp is much less safe in coal-gas than in fire-damp. 4. Explosive mixtures of coal-gas and air may be inflamed by sparks struck from metal or stone. Thus an explosion may arise from the blow of the tool of a workman against iron or stone, from the tramp of a horse upon pavement, &c. 5. Explosive mixtures of coal-gas may also be ignited by a body of a comparatively low

temperature, through the medium of a second body, whose igniting point is lower than that of coal-gas. Thus sulphur, or substances containing sulphur, may be inflamed far below visible redness; and the contact of iron below a red heat with very inflammable substances, such as cotton waste, may give rise to flame, which will then, of course, ignite the gaseous mixture.

ILLUMINATING POWER OF THE GAS SUPPLIED TO THE CITY.

At a meeting of the City Sewers Commission Dr. Letheby has presented his report on the Illuminating Power of the Gas supplied to the City of London during the autumn quarter by the Great Central Gas, the Chartered, and Commercial Gas Companies. The gas had been tested in accordance with the instructions of the Metropolis Gas Act of 1860. It had been tested at two places, namely, at the London Hospital and at Finsbury-square, and 325 examinations had been made. The results were, that the mean illuminating power of the Great Central Gas was equal to 13·34 sperm candles of the standard quality, that of the Chartered to 13·78 candles, and that of the Commercial to 13·02. The weekly average of the Great Central had ranged from 12·69 to 14·93, and that of the Commercial from 12·41 to 13·85. The difference in the mean illuminating power of the Great Central Gas at the two places where it has been tested, namely, at Finsbury-square and the London Hospital, which are nearly two miles apart, differed only to the extent of 0·45 of a candle, and as the largest average (13·55) was at Finsbury-square, it was manifest that the difference was accidental. These results indicate that the gas supplied in the City by the three companies has not, during any week, been below the standard quality, and that the quarterly averages have been from 8·5 to 0·15 per cent. above it. The former is the excess of the Commercial average, and the latter of the Chartered; that of the Great Central having been 13 per cent. over the standard. Last year at this time the quarterly average of the Great Central was only 12·16 sperm candles, and the mean illuminating power of that gas for the corresponding quarter of the last seven years has been 12·55 candles. The quality is therefore improving.—*Mechanics' Magazine.*

EXPLOSION OF COPPER GAS-PIPES.

Dr. Phipson, in a letter to the *Times*, states:—It has been discovered that when Gas-pipes constructed of Copper or Bronze have been long submitted to the action of ordinary coal-gas, an explosive compound of copper and acetylen (one of the many ingredients of coal-gas) is formed. When dry, this compound detonates with extraordinary violence as soon as it is rubbed, struck, or heated. Already some accidents have occurred, and some workmen have lost their lives while cleaning large copper gas-pipes from this circumstance. No such explosive compound appears to be formed when iron or lead are used. It is evident

that large copper gas-pipes are unsafe, and that some other metal should be substituted for the copper, as the latter may give rise at explosions at any moment. As concerns small pipes constructed of this metal, they should not be allowed to get foul, and when about to be cleaned, hydrochloric acid should be introduced into them for about 10 minutes before they are submitted to any heat or friction. Hydrochloric acid decomposes the explosive compound, combines with the copper, and puts the gas acetylen at liberty. The acid may then be washed out with hot water.

GYE'S GASOMETERS AND TANKS.

MR. FREDERICK GYE, of the Royal Italian Opera, Covent Garden, has invented certain improvements in constructing Gasometers and Gasometer Tanks. He constructs a gasometer tank in such a manner as to render available much of the central space of land now covered or occupied by the tank of a gasometer. The tank is made double at the outer circumference to receive the water or fluid employed, the interior space being left free for use when roofed, or closed in air- and gas-tight. Instead of placing a gasholder tank on the surface or below the surface of the ground, Mr. Gye erects a circular wall of brickwork, or a circular framework of iron or other suitable material. This circular erection may be perforated with arched or other openings, of a height convenient to admit men or materials being carried through them. The breadth of this wall or erection is to be sufficient to admit of a double or ring gasholder tank being placed on its upper surface; the tank being of sufficient width to admit of the working therein of a single or double, that is, a telescope gasholder. The space extending from one side of the interior tank to the other is to be roofed over. There is then a covered circular apartment approached by the openings through the circular wall or structure below. The roof of this apartment may, if necessary, be conveniently supported by a central column with radiating struts (umbrella-like) or by a series of columns or otherwise. This invention is also applicable when constructing gasometers, the tanks of which are built below the level of the surrounding ground, and for which an excavation has been made; only, in that case, it would be necessary to descend by an inclined plane, or other means, in order to enter the enclosed covered space under the gasometers. As the action of the wind might be found inconvenient, the outer ring of the tank may be made of a height equal, or nearly so, to the greatest height to which the outer gasholder will rise when completely filled with gas; and on the inside surface of this outer ring are placed either the wheels or the guide-rods necessary to the steady working of the holder.—*Builder.*

GASLIGHT IN RAILWAY TRAINS.

MR. ALLEN, of the Scottish Central Railway, has succeeded in

lighting trains on this line. The gas is supplied from a large boiler at the Perth station, which is filled from the gas-works there. The supply for the train is kept in an india-rubber gasometer of about six feet square, defended by iron rods, and kept in a compartment of the break-van. When full it occupies the whole of this compartment, but as the gas passes away it is compressed by a weight on the top. The gas is conveyed into it from the boiler, by a large tube in the bottom of the van, and is conveyed out of it to supply the carriages by a smaller tube, also in the bottom. This tube again passes up through the anterior part of the van to the roof, and the gas is thence conducted along the carriages by metal pipes, connected by india-rubber tubing, and passes down by brackets into large and strong glass globes in the various divisions of the carriages. The supply necessary for the double journey to Perth and back, which occupies somewhat less than eight hours, is about 260 cubic feet; and the expense, after the fittings are completed, is estimated at one-half of that of the ordinary oil apparatus. The only objection to the scheme is that it must be confined, except with great difficulty and expense, to trains which do not require to be taken down, such as those for long journeys and express trains; but, as it is in these that light is most required, the objection is not a strong one. The system has been for some time in operation on the Lancashire and Yorkshire, and London and North-Western Railways, and was introduced on the former line by Mr. Newall, inventor of the patent break.—*Caledonian Mercury*.

STEAMBOATS LIGHTED WITH GAS.

THE Wallasey Commissioners, says a Liverpool paper, who have taken the lead in introducing the most perfect construction of ferry-boats that ever floated on the waters of the Mersey, have had a splendid new boat, the *Water Lily*, built by Messrs. George Forrester and Co., and Messrs. Jones, Quiggin, and Co., now Lighted by Gas throughout. Instead of the dull, lurid flame produced by oil, the signal lamps are brilliantly illuminated by a jet of the clearest gas-light. At night the engine-room is now quite light, every part of the machinery, in fact, being more clearly visible to the engineer than during the day-time; while a couple of sun-burners at once give light and ventilation to the passengers in the saloons.

NEW SYSTEM OF LIGHTING THEATRES.

THE last and by far the most important of the novelties of structure and decoration attempted (and with success) in the new Théâtre du Châtelet in Paris, is the entirely original mode of Lighting the *salle*. Not a single chandelier appears, large or small; and yet the house is perfectly lighted, and the richness of the architectural effect, strange to say, seems absolutely to gain by the absence of those glittering accessories of glass and lights which usually form such principal features in theatrical

interiors. In lieu of these we are presented with a ceiling of ground glass, sparingly decorated with elegant arabesques, above which, and unseen, are jets of gas, arranged in a concentrated mass, which pour down a flood of softened and equalized light through the semi-transparent ceiling, the intensity of which can be heightened or diminished at pleasure. Not only is the glare of the chandelier, by which the view of the stage from some parts of the house was obscured, effectually removed, but the unwholesome heat and noxious fumes produced by a number of gaslights are also got rid of—a most important improvement.—*Building News*.

PREVENTION OF FIRE.

MR. M. ALLEN, of Shoreditch, has patented the "Construction of Buildings for the Prevention of Fire." The patentee proposes to construct buildings in an improved manner by economizing the space which the staircases usually occupy, and to render them fire-proof by dividing or insulating the staircases from the building of which they form part. This he proposes to accomplish by arranging the stairs (which are to be made of incombustible materials) in a recess formed in the outer wall of a building; which recess is to extend from the foundation to the roof, and have no opening whatever on its inner side; but it is to be provided, where necessary, with openings or doorways on its outer face, leading to balconies (which are also to be formed of incombustible materials) fixed at the level of, and giving access to, each of the floors or flats of the building. By means of this arrangement of staircase and balconies, each floor will be rendered totally distinct from, and independent of, that one below or above it, so far as regards any internal communication therewith or therefrom. The invention also consists in obtaining and forming a new material for building purposes, by the combination of cinders, slags, coke, culm, clinkers, or other calcined substances of similar character thereto, possessing an irregular, uneven, or porous surface, with Portland or other cement. Long ago it was suggested in the *Builder* that the formation of circular staircases projecting from the back or side of the houses, as is not uncommon in Scotland, with stairs of incombustible material, would tend materially to lessen the spread of fire, besides ensuring safe means of transit for the occupants of a house on fire.

Mr. Bayliss, Madeley, Shropshire, has patented certain improvements applicable to buildings, in order to facilitate the extinguishing of any conflagration which may happen therein. This invention consists in constructing buildings with each apartment or compartment with an aperture or apertures at the upper part, the said apertures being in (or communicating with) tubes or channels opening into the nearest chimney or flue; or the tubes or channels may be continued and opened into the external atmosphere. Hence, if a conflagration should take place, it will only be necessary to close the apartment or compartment, and the smoke and fire will find vent by the said channels, flues, or tubes. Also,

for the purposes aforesaid, the patentee provides a cistern or receptacle at the upper part of the building, from which pipes descend which reach from the said cistern to the basement of the building, and may form supporting columns or pillars to it. The tops of the said pipes, where they open to the cistern, have proper valves; and from these pipes, at every floor of the building, other pipes or channels branch out in such manner that valves may be applied to stop the first-mentioned pipes at the level, or nearly so, of such branching pipes; causing such flow of water from the cistern to run into the said branching pipes or channels; and thence, through suitable apertures, into the apartment or compartment, or any two immediately adjoining or contiguous apartments or compartments; and this without allowing the entry of the water into any other apartment or compartment. The floors and roofs should be fireproof.

LONDON FIRES.

THE Select Committee of the House of Commons appointed to inquire into the existing arrangements for the Protection of Life and Property against Fire in the Metropolis have concluded their labours. It appears that twenty years ago the number of fires in London was about 450, and that last year the total number was 1183. According to Sir Richard Mayne's estimate, the whole of the metropolitan police area and the City of London together, extending over about 700 square miles, may be considered as containing rather above 3,000,000 of inhabitants, residing in about 475,000 houses, and the rental for taxation about 14,800,000*l*. The magnitude of the interest at stake was also shown by Mr. Newmarch, who stated in his evidence that the total value of property insurable against fire within six miles of Charing Cross is not less than 900,000,000*l*., and of this not more than about 300,000,000*l*. are insured. It was further shown that this insured property now bears, through the medium of the fire offices, the expense of the present Fire Brigade establishment. The Committee express their opinion that the parochial arrangements required by law for the extinction of fires should be discontinued; though maintained at a cost supposed to be nearer 10,000*l*. a year than 5000*l*., they are useless, or worse. The Fire Brigade establishment of the insurance offices is also totally inadequate to the general protection of London from fire; nor can the offices be expected to undertake the task; their object is the especial protection of those parts where the largest amount of insured property is to be found; they are, moreover, anxious to give up the brigade. But its efficiency is such that the committee consider that the services of the existing staff ought to be made available in connexion with any new system which may be adopted. The valuable services of the Society for the Protection of Life from Fire also demand public acknowledgment. In Liverpool the fire brigade forms an integral part of the police force; the

arrangements are very efficient, and yet the annual expense is but about 2800*l*. At Manchester and Glasgow also the arrangements are made under local Police Acts; the expense is about 2000*l*., and half of it is recovered from the owners of the property in which fires occur, or from the insurance offices. It was proposed in the committee that such a charge should be made upon owners or insurance offices in London, but the numbers were equal on a division, and the chairman gave his vote with the Noes. In these three towns there is an almost unlimited supply of water at a high pressure, so that hose pipes are applied to the water mains, and the use of fire engines almost dispensed with; but such a supply for the whole of the metropolitan district, requiring as it would a new system of fire mains, could not be effected without a cost of about 3,000,000*l*.; better regulations, however, might be made for the immediate attendance of the fire-cock men. The Committee, by a majority of seven to five, agreed to the following recommendations:—"1. That a fire brigade be formed, under the superintendence of the Commissioners of Police, on a scheme to be approved by the Secretary of State for the Home Department, to form part of the general establishment of the Metropolitan Police, and that the Acts requiring parishes to maintain engines be repealed. 2. That an account of the expenditure of the new police fire brigade be annually laid before Parliament, together with the general police accounts, in such a manner that the special cost of the brigade may be ascertained. 3. That the area of the new fire brigade arrangements be confined within the limits of the jurisdiction of the Metropolitan Board of Works, with the option to other parishes to be included, if within the area of the Metropolitan Police."

The usual annual return on this subject has been issued by the superintendent of the London Fire Brigade. The total number of calls received during the year 1861 was 1409; of these 89 were false alarms, 137 proved to be only chimney alarms, and 1183 were fires, of which 53 resulted in the total destruction of buildings, &c., 332 in considerable damage, and 798 in slight damage. The fires of 1861, compared with those of 1860, show an increase of 127, and compared with an average of the 28 years during which the establishment has been in existence, the increase is 391. This list does not include trifling damages by fires not sufficiently important to require the attendance of firemen. Of these no record is anywhere kept, but they may be estimated in round numbers at 4000; neither does it include the ordinary calls for chimneys on fire, which may be roughly estimated at 3000. The totally destroyed list, 53, is 25 in excess of the same list for 1860, and 13 in excess of the average proportion for the 28 past years. Of the premises burned, 20 were from 2 to 7 miles distant from the nearest station; 25 were used for the carrying on of hazardous trades, such as cabinet-makers, carpenters, hay and straw salesmen, steam saw-mills, &c.

PRESERVATION OF WOOD AND IRON.

Mr. Thomas Cobley, of Meerholz, proposes to Preserve Wood, and render it uninflammable, by impregnating it with a solution of salts of barytes, strontia, potash, lime, magnesia, or other salts, or the salts of any base capable of forming salts with hydro-fluo-silicic or silicic acid. After the impregnation, which may be effected by any known means, the wood is further acted upon by treatment with similar acids.

An invention has been patented by Mr. John Cullen, of the North London Railway, Bow, for preserving wood from decay. The inventor proposes to use a composition consisting of coal-tar, lime, and charcoal. The charcoal is reduced to a fine powder, and such is the case also in regard to the quick lime. These materials are to be well mixed together, and subjected to heat. In order to preserve wood, the composition is heated, and the wood is immersed therein. The impregnation of the wood with the composition may be materially aided by means of exhaustion and pressure. Wood thus prepared is said to resist the ravages of the white ant. When coating iron to preserve it from rust, the composition is heated for a time to somewhat higher temperature than is found necessary for wood.—*Builder*.

PRESERVATIVE ACTION OF SULPHATE OF COPPER ON WOOD.

The experiments of Mr. Kœnig are said, by the *Repertoire de Chimie*, to have demonstrated that Sulphate of Copper deprives Wood of the nitrogenous matter which acts as a ferment, this matter being found in the solution of Copper. At the same time a combination of resin and copper is formed, which closes up the pores of the wood and preserves it from the action of the air. The wood, however, is still susceptible of decomposition, in consequence of the variations of temperature and humidity. Mr. Weltz, while occupied with the solution of the last questions, has arrived at the following conclusions:—He has remarked that the wood gradually blackens as the layers of metallic copper are produced on it. The sulphate of copper is fixed in the wood: this salt decomposes itself into metallic copper and sulphuric acid. The latter chars the wood; and it is through this layer of charcoal, the preserving agency of which has been so often remarked, that the wood is enabled to resist the action of humidity.—*Builder*.

PREVENTION OF ROTTING IN WOOD.

To prevent Posts and Piles from Rotting, the following coating has been recommended in *Herapath's Journal*. Besides being economical, it is said to be impermeable to water, and nearly as hard as stone:—Take 50 parts of resin, 40 parts of finely powdered chalk, 300 parts or less of fine white sharp sand, 4 parts of linseed oil, 1 part of sulphuric acid, and 1 part of native oxide of copper. First heat the resin, chalk, sand, and oil in an iron boiler; then add the oxide, and with care the acid: stir the composition

carefully, and apply the coating while still hot. If it be not liquid enough, add a little more oil.

The following method is given in the new periodical entitled *The Exchange*:—

All fence-footings, gate-posts, garden stakes, and timber that is buried in the earth, may be preserved from decay by the following simple process:—Take 11 lb. of blue vitriol to twenty quarts of water: dissolve the vitriol with boiling water, and then add the remainder. The end of the wood is then put into the solution, and left to stand four or five days: for shingles three days will answer; and for posts 6 inches square, ten days. Care should be taken that the saturation takes place in a well-pitched tank or keyed box, for the reason that any barrel will be shrunk by the operation so as to leak: instead of expanding an old cask, as other liquids do, this shrinks them. Chloride of zinc will answer the same purpose, but it is dearer.

SOLUBLE GLASS.

Mix ten parts of carbonate of potash, fifteen parts of powdered quartz, and one part of charcoal. Fuse well together. The mass is soluble in four or five parts of boiling water, and the filtered solution, evaporated to dryness, yields a transparent glass permanent in the air.—*Chemical News.*

WATERPROOF GLASS ROOFS.

A patent has been taken out by Messrs. Showell, of Manchester, for Waterproof Glass Roofs, recommended as especially applicable to railway stations and horticultural buildings. The invention consists of plates of glass, with the edges only turned up; and where they meet one another, protected by a metal cover. The top edge of the glass rests upon a horizontal flange L iron purlin, and the bottom edge on the edge of the vertical flange; so that the top edge of the glass is overlapped by the bottom edge of the plate above. A screw bolt passes through the bottom end of one cover between the two adjacent plates of glass under this cover, through the top of the cover immediately under it, and between the edges of the two adjacent plates of glass under this cover, and is then secured through the horizontal flange of the L iron purlin. A pin passes through the sides of the bottom end of the covers, and prevents the glass plates from slipping down, by catching their turned-up edges. There is a further improvement, in which the top and bottom edges of the plates of glass are turned the one up and the other down. In this form a more secure joint, it is said, is effected at the top and bottom edges of the glass, and with a less lap. The top end of each cover prevents the glass plate next above it from slipping down by catching its turned-down edge, and no pin is required. By this new form of construction no putty is needed in the joints; and expansion and contraction, or any other slight movement, can go on without impairing the waterproof construction.—*Builder.*

PAIL-MAKING BY MACHINERY.

In making a Pail, it goes through a good many operations, and at each time by a separate individual. The staves are first cut to the proper length; they are then placed in a machine, which hollows out the inside and rounds the outside; they are then joined, passed from that to be tongued and grooved; they are then ready to be put up, which is done in quick style; as the staves are all cut the same width, there is no time lost in picking out the proper size. They are formed upon an iron cylinder, and turned off on the outside; the hoops, already prepared, are run on tight by a small machine. The insides are then turned out and passed to another workman to have the bottom put in; this is the principal part of the work, although they have to get the ears and bails put on, and painted and varnished, before they are ready for market. One house in Ottawa city, Canada, turns out 800 pails per day.

MACHINE FOR CUTTING COAL.

A new Coal-cutting Machine, worked by compressed air, has been tried with success in Yorkshire. The engine-house contains a powerful engine, besides the compressed-air engine. The "pressed air" is conducted in patent bitumenized pipes to a distance of nearly a mile from the bottom of the driving shaft, the pressure being about 50 lb. to the inch. The agency is said to be delivered to the cutter almost with the same motive force that it has at the pit-head. The cutter itself is a machine made to run on the tub-carriage way. While the cutter is working a stream of pure atmosphere is discharged at every stroke; and this current of fresh and dry air cannot fail to add considerably to the ventilation. Economy and safety are said to be the chief recommendations of the invention.—*Builder.*

COAL-MINE ACCIDENTS.

A Parliamentary return states that in the 10 years commencing with 1851, 605,154,940 tons of coal have been raised in Great Britain, and the number of lives lost at the work has been 8466—a life lost for every 71,480 tons of coal raised. The 5,000,000 tons which are brought to London every year must therefore occasion, on an average, no less than 70 deaths, or about one every five days. In some mining districts the deaths are described as being far beyond this average; in South Wales, for instance, and in the South Staffordshire and Worcestershire district, they have been double the average.

DIAMONDS USED FOR BORING INTO HARD ROCK.

An instrument for this purpose has been employed in France, made out of a tube furnished with a circular cutter of rough Diamonds. It is caused to revolve, and as it enters into the stone the cutter scoops out a cylinder, which is afterwards easily taken

out of the tube. Holes in hard granite for blasting purposes, 47 millimètres in diameter, and from 1·10 mètres to 1·20 mètres deep, are thereby bored in one hour. This would require two days' work in the ordinary way. The diamonds, when examined through a magnifying glass, do not seem at all injured.—*Cosmos.*

NEW MORTISING MACHINE.

THIS invention, by William Jackson, of Leeds, consists of "Improvements in Mortising Machines," connecting the hand lever of a mortising machine to the apparatus which carries the cutting tool by means of a link, so as to produce the required vertical motion of the cutter or chisel. The spindle to which the cutting tool is fixed passes through an upright casing, or box, or cylinder fixed upon the spindle. These two parts move together vertically; but the spindle has an independent axial motion, so that the position of the cutter may be altered when required. The cutting operation is effected by bringing down the chisel by means of the hand lever; and the wood under operation may be moved forward as required by means of the toothed gearing connected with the moveable bed on which the wood is secured.

A TELESCOPIC LADDER.

THE *Hereford Times* states that a very ingenious invention, called the Telescopic Ladder, has just been patented by the inventor, Mr. G. H. Morgan, surveyor and builder, New Market-street, in that city. This ladder, which might be made to a great length, shuts up like a telescope, the uppermost *floor*, so to speak, shutting up in the next, and so on to the bottom; in like manner, the first floor is easily projected, and may be turned against a wall at any angle: then follows the second, third, fourth, &c. The whole series shuts up into a small compass.

TO PREVENT TOOLS FROM RUSTING.

THOUSANDS of dollars are lost each year by the Rusting of ploughs, hoes, shovels, &c. Some of this might be prevented by the application of lard and resin, it is said, to all steel or iron implements. Take three times as much lard as resin, and melt them together. This can be applied with a brush or cloth to all surfaces in danger of rusting, and they can easily be kept bright. If tools are to be laid by for the winter, give them a coating of this, and you will be well repaid. It can be kept for a long time, and should always be on hand and ready for use.—*American Country Gentleman.*

STONE-CUTTING BY MACHINERY.

MR. HUNTER, of Dean Forest, in Wales, has patented a Stone-planing and Ridge-dressing Machine, so elaborate in its motions that it will perform with speed, accuracy, and regularity of finish

nearly the whole of the masonwork, hewing, dressing, &c., now executed by hand previous to the operation of building. It will plane, dress, and polish stones; work out checked rabbets and window-sills; and do almost everything appertaining to plain masonry; giving to ashlar work an ornamentation quite unique. This machine is an amplification and completion of the inventor's idea that seven years ago found expression in the ridge-dressing machine which was then patented. From the appearance of the machine, and the thorough success of the ridge-dresser, there is no reason to doubt that an equal success will attend this new invention.—*Builder*.

ARTIFICIAL STONES.

PROFESSOR ANSTED has read to the British Association a paper "On Artificial Stones," in which he described the various materials and contrivances used for the purpose of replacing stone where natural stone could not be obtained with advantage. He described in succession terra cottas, cements, and piliceous stone, describing the nature, properties, uses, and disadvantages of each. He alluded to his own observations on the subject, and also to that of the preservation of stone as connected with it. He then described a new and very remarkable material recently introduced by Mr. Ransome, and experimented on by the chemists of the Committee of Chemists and others appointed last year by the Board of Works in reference to the Palace at Westminster. This material was afterwards manufactured in the presence of the section by Mr. Ransome. It consists of any kind of mineral fragments, sand, limestone, or clay, mixed into paste by a mould with fluid silicate of soda (obtained by digesting flints in a steam-boiler under high pressure in alkali), and afterwards dipped into a solution of chloride of calcium. The result is an almost immediate hardening of the pasty mass, and the specimens constructed were within a few minutes handed about the room. One specimen, weighing two tons, was in the International Exhibition, while others may be seen in the new façades of the Metropolitan Railway. These afford sufficient proof of the extent to which the manufacture has already advanced.

A discussion ensued, chiefly on the subject of the preservation of stone, in which Mr. E. Barry and other gentlemen took part. Professor Ansted then explained to the section the result of the labours of the Chemical and Geological Sub-committee, of which he had been a member, in regard to the preservation of the stone of the new Houses of Parliament.

Mr. Frederick Settle Barff, of the city and county of Dublin, has patented the invention of "Improvements in the production of artificial stone, which improvements are also applicable to the preservation of stone, bricks, tiles, and other analogous substances or materials." The following is a quotation from the specification:—

"To obtain artificial stone by my improved process, I employ powdered

pumice-stone in combination with soluble silicates, such as silicate of soda or silicate of potash; the said silicates being combined with or decomposed by carbonate of lead, carbonate of zinc, or other suitable material insoluble in water, which will decompose or chemically unite with the said silicates. The proportions I prefer to employ are as follows:—Silicate of soda (sp. gr. 1470), or otherwise as above mentioned, 10 drams by measure; powdered pumice-stone, 2 lb. by weight; carbonate of lead, or otherwise, 4 oz. by weight. Which composition, when placed in moulds of the required form, sets of itself, and becomes hard and insoluble in water without the agency or action of heat. Proportionate quantities of chalk, sand, or other similar or suitable substance may also be incorporated with the compound, and thus enable it to be obtained at less cost in accordance with the nature or description of the work to which it is intended to be applied."

Dr. Frankland, F.R.S., has experimented with a discovery made and patented by Mr. Frederick Ransome, of Ipswich, in connexion with his well-known artificial stone, produced from water-glass and lime, with clay. Heretofore this artificial stone, after its formation in a plastic state, required about one month to dry, and another to be kiln-burnt. Now, it seems, the plasticity is superseded by stony hardness, not only without either drying or kiln-burning, but also in an hour or two's time! The moulded or prepared stone requires simply to be dipped into a solution, and the work is done, even when the stone has been one weighing a whole ton weight or more. The solution consists of chloride of calcium; or, as it is more properly called when dissolved in water, muriate of lime. When the moulded matter is dipped into this solution it is very soon saturated with it, and a double decomposition takes place: the lime combines with the silica, forming a silicate of lime, which is one of the two chief cementing materials in all our cements, mortars, and concretes (carbonic acid being the other): the muriatic acid combines with the soda of the water-glass, forming common salt, which is said to be "washed off." How this can be, however, we do not see clearly: it must pervade the whole substance of the new-made stone; and might certainly be rapidly extracted by boiling water, or more slowly by cold water, or by rain *in situ*, leaving the stone more porous than before; but we do not mean to insinuate that hence the new-made stone cannot be a permanent and really stony product. Indeed, Dr. Frankland's experiments with it seem to show that it must at once possess remarkably weather-resisting powers. On this point he says, keeping in view the result of his experiments, "I should scarcely have imagined it possible that an artificial material could in so short a time, and without any application of heat, have attained such weather-resisting powers." It was found, however, as was to be expected, that the stone experimented on *contained* chloride of sodium; so that this salt had not been "washed off;" but it seems to be extractable without injury to the tenacity of the stone, although with an increase of porosity, as Dr. Frankland remarks. Of the general results of his experiments, Dr. Frankland says:—"Whilst they point out the Portland, Whitby, Hare Hill, and Park Springs, as the natural stones best adapted to withstand the

influences of town atmospheres, they also indicate that Ransome's patent concrete will be found equal to the best of these in its power of resisting atmospheric degradation; and, if the newness of Ransome's stone (the specimen experimented upon not having been made a fortnight) be taken into consideration, together with the well-known fact that its binding material, silicate of lime, becomes harder and more crystalline by age, I am induced to hope that Mr. Ransome has invented a material which, with the exception of the primary rocks, is better capable of giving permanency to external architectural decorations than any stone hitherto used."—*Builder.*

CEMENT FOR ROOMS.

A RECENT invention by M. Sorel is described to consist in the discovery of a property possessed by oxychloride of zinc, which renders it superior to the plaster of Paris for coating the walls of rooms. It is applied in the following manner:—A coat of oxide of zinc mixed with size, made up like a wash, is first laid on the wall, ceiling, or wainscot, and over that a coat of chloride of zinc applied, being prepared in the same way as the first wash. The oxide and chloride effect an immediate combination, and form a kind of cement, smooth and polished as glass, and possessing the advantages of oil paint, without its disadvantages of smell.

SCENE-PAINTING.

M. J. FOUCAULT proposes to remedy certain defects in scenic arrangements by the following means. At present, our mountains, towns, and villages are of one piece with the back-scene; and while nature presents objects to us through a cone of visual rays drawn from the eye, the stage represents them in an exactly inverted position—that is, we see them through the base instead of through the vertex of the cone. By M. Foucault's ingenious and artistical plan all these inconveniences are obviated. The sky being so often required, he has made the upper part of it fixed, of a dome-like shape, as in nature; the lower or perpendicular part is of canvas stretched on frames, and arranged cylindrically, so as to form a panorama, the end of which cannot be perceived from any point of the house. His mountains or towns of the background are independent of the sky, and stand forth in real relief; so do his trees or shrubs, which are made to rise from or descend below the floor. As for those objects which are nearer the foreground, they are made of two pieces, the lower one to sink down, the upper one, a fly, to be drawn upwards when a change of scene is required. His views of the sea or of interminable plains display a vast expanse never yet seen on a stage; rich architecture is also cut out and shows beautifully on the fixed sky of the background, which, however, is so contrived that all the phenomena of storms, sunset, approaching night, travelling clouds, with varying illuminations, &c., are imitated with surprising fidelity.

INDUSTRIAL PAINTING.

A REVOLUTION in Industrial Painting is reported by Mr. Moigno in the *Cosmos.* He visited the electro-metallurgical workshops of Mr. Oudry, at Auteuil, who some time ago showed how galvanic copper can be reduced to an impalpable powder, so as to form the basis of a new paint. A later idea is that of laying on the copper-dust on the coating of benzole always put on the surface of casts before covering them with copper by the galvano-plastic process. He has eventually succeeded in obtaining a mode of painting by means of galvanic copper, applicable to wood, plaster, cement, steel, iron, the exterior of ships, &c. ; giving them a covering perfectly dry and inodorous after twenty-four hours ; taking a very agreeable lustre ; and susceptible of receiving, by means of chemical re-agents, all the tones of bronze, &c., which may be given to pure copper. Mr. Oudry has also succeeded in combining with benzole, in addition to a very small quantity of copper, the colours which have lead, zinc, &c., as a base. As benzole, from its conversion into aniline, for the manufacture of dyes, is becoming expensive, Mr. Oudry was led to try mineral oils, now so abundant ; and found them quite as effectual as benzole. These hydro-carbons will thus replace the expensive drying vegetable oils, if Mr. Oudry's process be generally available. Mr. Moigno states that a very agreeable green has been given to the balconies of the new Théâtre Français by the new method.—*Builder.*

GOLDEN BRONZE FOR STATUES.

THE Paris correspondent of the *Birmingham Journal* describes a novelty in manufacture which, he states, has been accepted with great interest by the metallurgists of the Government. The discovery appears to have been purely accidental, and to have originated in what was at first regarded as a disastrous mistake, made by one of the workmen in the employment of Mr. Hullin, of the bronze powder factory at Chatelherault. The spilling of some chemical matter (which of course remains a secret) into copper and iron filings has produced two new metals or alloys, possessing every quality of gold and silver excepting weight. Both are inoxidable, and as rich and bright in colour as the real metals, of which they are rather to be deemed the humble rivals than the mere imitators. The price is fixed at fifteen francs the kilogramme ; and its cheapness has induced the experiment to be made public by the execution of a statue of Saint Anne, for the hermitage of Auray, in Brittany. The statue is intended to be of colossal proportions, and to adorn the roof of the grotto. Ancient bronzes were ordinarily gilt.

REPAIRING THE SILVERING OF LOOKING-GLASSES.

THE Repairing of the Silvering on the backs of Looking-glasses has hitherto been considered a very difficult operation. A new and very simple method, however, has been described before the

Polytechnic Society of Leipsic. It is as follows :—Clean the bare portion of the glass by rubbing it gently with fine cotton, taking care to remove every trace of dust and grease. If this cleaning be not done very carefully, defects will appear around the place repaired. With the point of a knife cut upon the back of another looking-glass, around a portion of the silvering of the required form, but a little larger. Upon it place a small drop of mercury : a drop the size of a pin's head will be sufficient for a surface equal to the size of the nail. The mercury spreads immediately, penetrates the amalgam to where it was cut off with the knife, and the required piece may now be lifted and removed to the place to be repaired. This is the most difficult part of the operation. Then press lightly the renewed portion with cotton : it hardens almost immediately, and the glass presents the same appearance as a new one.—*Builder.*

MACHINERY FOR PRINTING CALICOES.

An idea may be formed of the extraordinary influence which the introduction of Machinery and improvements in engraving have had in cheapening the cost of printed Calicoes, from the statement made by Professor Calvert, of the United States, that large furniture patterns, such as are required for some of the oriental markets, and into which sixteen colours and shades enter, would have cost formerly from 7 dols. to 9 dols. per piece, because they would have required sixteen distinct applications of as many different blocks, and would have required more than a week in printing, whereas the same piece can now be printed in a single operation, which takes three minutes, and costs about 1 dol. 50. —*Mechanics' Magazine.*

TWO-COLOUR PRINTING MACHINE.

We have lately seen a circular printed in Two Colours at one operation, by a Machine recently patented by Mr. W. Conisbee, of the Waterloo-road. The machine is of the same construction as the "Main," with the addition of some simple mechanism to enable it to print two or more colours at the same time. It has one cylinder only, two type surfaces, and two inking apparatuses ; each sheet to be printed requires but one feeding, the sheet being held in the machine until the requisite number of colours are printed. Two boys are enabled to execute the same quantity of work as four boys with the ordinary single colour machine. This machine will be found exceedingly handy for cross rule work with coloured headings. We understand that a double royal machine has been in successful operation for some time at Messrs. Waterlow and Sons', London-wall.—*Mechanics' Magazine.*

BANK-NOTE ENGRAVING AND PRINTING.

A new mode of Engraving and Printing Bank-notes has been brought forward by Messrs. Ashby and Co., which is asserted

to possess the recommendations—1. That they cannot be photographed, as the black printing is interlaced, in an extremely complicated manner, with another colour; 2. That the note plates cannot be copied, the ornamental engraving being executed by a machine from a matrix arbitrarily formed and made intricate by transposition in kaleidoscope fashion; and 3. That note plates engraved by such a matrix cannot be produced again by the engravers without the matrix, so that if that is destroyed, or handed to the custody of the bankers, they hold their own security.

With reference to this announcement, Messrs Bradbury, Wilkinson, and Co., state that they were the first to introduce the process of interlaced colour-printing for the prevention of forgery of bank-notes by photography, and that the process has been in practical operation by them for a considerable time. They add:—

"Specimens of the colour-security work were shown in our case at the Exhibition. These colours are specially prepared so as to defy removal, without which colour-printing is really of no security. At this moment we are executing a bank-note order for a foreign Government with four intricate coloured patterns besides the black. We may also mention that the only prize medal given to an English exhibitor for engraving and printing bank-notes, was awarded to us, as well as an honourable mention by another jury, two medals for the same class not being allowed."—*Times.*

NEW MODE OF MAP-ENGRAVING.

At a meeting of the Franklin Institute, Philadelphia, Mr. Samuel Sartain, engraver, of that city, has exhibited an impression of a large Map, devised and executed on a new and effective plan by Col. Baron Egloffstein, U.S.A. It illustrates the labours of the U.S. expedition for exploring the *Colorado River of the West* and surrounding country in New Mexico.

Baron Egloffstein, the topographer of the expedition, conceived the idea of endeavouring to give his map the appearance of a small plaster model of the country; and to do this he treats the forms of nature as an artist would draw any form before him—that is, by giving the real light and shade that would be developed by light falling on the model at a suitable angle. The mountains have their shadow-side engraved in the usual manner by "*hachures,*" but the light-side is only slightly tinted in parts to develop detail of form, and is brilliantly relieved by a tint spreading over the level plain like an Indian-ink wash; this tint is made of several grades of strength, intended to show the *relative altitude* of the several plateaus over which it is spread, the lowest or alluvial lands having the darkest tint, and the loftiest table-lands having the most delicate.

The result in the present map is bold and striking, showing at a glance the nature of the whole country, enabling any one to per-

ceive the character, prominence, and relation of the different parts. This region of country has features unsurpassed in their kind for grandeur and sublimity; the Colorado of the West flows for 300 miles of its course through Cañons whose sides often rise perpendicularly from 3000 to 6000 feet in height; the "Great Cañon of the Colorado" is the most magnificent gorge as well as the grandest geological section of which we have any knowledge. For this reason, Colonel Egloffstein's system of mapping has unquestionable advantages; its freedom from conventionality and its truth to nature, give it a power, unattainable by the old system, of representing forms so that they are intelligible to every eye.

The French at one time used a system of topography similar to this; it had light-sides and shade-sides to the mountains, but they did not tint the level plain, on which so much of the character and beauty of this style depends. The tint on the steel plate shown is machine-ruled (nearly 200 lines to the inch), and graded to the requisite strength by acids, giving by its fineness the appearance of delicate India-ink tints: this portion of the work was executed by Mr. Samuel Sartain, and excels as a specimen of this method of engraving.

PAPER IN JAPAN.

AMONG the botanical specimens sent over from Japan to the Société d'Acclimatation by M. Eugène Simon there are a few young trees, out of the bark of which the Japanese make very good and strong Paper. In China, the bark of the Broussonnetia papyrifera, a kind of mulberry-tree, is used; that of Japan is a variety of the same species, to which Van Sieboldt has given the name of Broussonnetia kaminoki. Considering the daily increasing difficulty of meeting the demand for rags, which are sold at about 2*l*. per cwt., the bark of this tree imported from Japan would prove extremely valuable to the paper trade, inasmuch as it would not cost more than half that price. The kaminoki might be easily acclimatised in various parts of Europe. It prefers a stony soil, especially of a calcareous nature, and should be planted at intervals not exceeding three feet; otherwise the branches would extend, whereby the bark would become full of knots, causing much loss of substance in the manufacture. The soil is not manured until the second year; in the autumn of that year the plant is lopped close to the root, and this operation, as well as that of manuring slightly, is repeated every second year. 100 lb. of branches thus obtained, stripped of their leaves, yield 10 lb. of bark. The branches on arriving at the manufactory are put into hot water for half an hour; the bark can then be easily stripped off with the hands: it is afterwards left in the sun to dry. It is next macerated for three days in river water, and bleached in the sun. These operations having been several times repeated, the bark is at last boiled in a lye of ashes for the space of three hours, then manipulated for some time to separate any epidermis that may

have remained; and lastly, when dry, the mass is pounded fine and made into a pulp with water, to which a glutinous liquid extracted from a shrub called nebooriko, probably the Accia nemu, is added, in the proportion of about two pints per cwt. of pulp. The latter is then made into sheets much in the usual way.

ASBESTOS PAPER.

IN the Northern States of America, Asbestos is found in rather large quantities, in fine, long silky threads. The low price of this mineral, its power of resisting heat, and its low heat-conducting power, have led to experiments for using it in Paper-making. This paper contains about one-third in weight of asbestos. The paper burns with a flame, and leaves a white residue, which keeps the shape of the sheet if carefully handled. Any writing in common ink is perceptible even after the organic substance of the paper is consumed.

BANK-NOTE SPLITTING.

MR. THOMAS MILLARD, one of the Queen's bookbinders, under the librarian at Windsor Castle, has exhibited his method of Splitting Bank-notes or any other sheets of paper. Specimens of the young man's ingenuity, consisting of a 5*l.* Bank of England note, a sheet of the *Times*, of the *Illustrated London News*, of the *Bath Journal*, and of the *Daily Telegraph*, each of which has been split cleanly and cleverly into two parts, without any rent or tear, have been exhibited. The engravings in the illustrated journal are brought out more clearly by the process, and when mounted on cardboard present a strikingly improved appearance. The discovery is applied by Mr. Millard to practical use in print-mounting, and in repairing torn leaves of books, which he can so skilfully manage, that the junction of the new and old paper can with difficulty be distinguished. The mounting of old prints upon paper is also so complete, that the specimens we have seen seem impressed upon the original paper. Unscrupulous people would certainly turn this plan of bank-note splitting to profitable account, if they could find it out, inasmuch as the halves could be made as stiff as the whole, the blank parts could be printed in imitation of the original, and the water-mark would, of course, be perfect. Mr. Millard, to prevent the difficulty which might arise to the Bank of England for having their water-mark left on blank pieces of paper, upon which might be printed *facsimiles* of their notes, suggests a plan for the prevention of the fraud. *

NEW ZEALAND FLAX.

MR. G. A. ANSTEY has addressed a communication to the *Times*, on the adaptability of the Fibre Machine of Mr. Guild for cleaning New Zealand Flax. He writes as follows :—

Though *Phormium tenax* had not then entered into the list of

* See Mr. Baldwin's mode of Splitting Paper, *Year-Book of Facts*, 1849, p. 105; and notes on the same subject, in *Year-Book*, 1850, p. 119.

the textile fibres in his prospectus, I found that he had already tried one imperfect leaf, and from the result judged favourably of its fitness for the operation of a machine specially adapted to it.

I furnished him with three or four fresh leaves, which I had obtained through the kindness of Messrs. Veitch, the eminent nurserymen: they were from a delicate plant grown under glass. The machine, though fitted with very large teeth, expressly for thick leaves, such as those of the aloe, and, therefore, far too long for a fair trial, nevertheless dealt with the flax leaf, and delivered its fibre perfectly clean, the gummy matter apparently all washed away. Since then I have witnessed its action on some dry leaves of New Zealand flax 12 months old, obtained by Mr. Guild through another channel.

Though nothing could look less promising than such material, the machine in an instant decorticated the leaves, while the ingenious contrivance of the flowing water completely cleansed the inner fibres from all the refuse.

Even the flax machine, though designed solely for European flax, scutched the same dry leaves, producing in an instant a clean fibre fit for immediate working into rope, but of course inferior in purity to that cleaned by the wet process of the fibre machine.

At this moment, when all the earth is being searched for new textile fibres for the support of our paralysed industry, I think it most important that the possibility of thus economically cleaning New Zealand flax should be generally known. From the days of Captain Cook its usefulness has been known, but all attempts at cleaning by machinery have hitherto practically failed, the simple method of the sharpened shell, in vogue among the natives at the first discovery, being still in practice, and the ordinary local requirements of cordage, &c., are mainly supplied from Europe and India, as being cheaper than the conversion of the native material by the ancient process.

I enclose you a portion of the flax cleaned by Mr. Guild.

I have taken the liberty of troubling you now, under the belief that a textile fibre abounding in any desirable quantity over 15 deg. of latitude, hitherto only encumbering the earth, must be important at this juncture to the manufacturing interests in England.

COTTON AND INDUSTRY.*

MR. BAZLEY, M.P., has read to the Royal Institution a paper entitled "A Plea for Cotton and Industry." Among the remarkable points in the history of the cotton manufacture dwelt upon

* We recommend all who are in quest of sound and trustworthy information as to Cotton, to refer to the volume by Mr. Joseph Gibbs, C.E., on *Cotton Cultivation in its various Details* (E. and F. N. Spon, 1862). Mr. Gibbs's extensive knowledge of the Cotton Plant in India and in Egypt should qualify him to speak *ex cathedrá* on its cultivation. Mr. Gibbs's instructions embrace the whole detail of the cultivation of Cotton, the result of long and laborious personal observation and experience in the native countries of the staple.

were the extraordinary conjunction of men of genius in the last century (Hargreaves, Arkwright, Crompton, Watt, and others) in creating the requisite machinery; the enormous increase in the production of cotton in North America, due to the invention of Whitney (in 1700, 1,000,000 lb. were consumed in the United Kingdom; in 1860, 1,000,000,000 lb.) and the great amount of the exports of this country, one-third of which are cotton goods. This, of course, caused a corresponding increase in the imports, and consequently in the revenue and prosperity of the country. The basis of this was insecure. In 1852 Mr. Bazley protested against our totally depending on North America for our supply of cotton, and recent events have proved the justice of his views. Of the 2,523,000 bags of cotton consumed in this country in 1860, eighty-five per cent. came from the United States, eight from Egypt and other countries, and only seven from the British East and West Indies. This rate is, however, rapidly changing. Whilst the supply from North America is passing away, that from the British possessions is greatly increasing—especially in India, from which much may be expected, in consequence of the changes in the Government and the construction of railways and canals. Mr. Bazley exhibited specimens of cotton cloth fron the East and West Indies and Australia fully equal in quality to the best from New Orleans.

SUBSTITUTE FOR COTTON, AND NEW MATERIAL FOR PAPER.

THE Paper panic which sprang up a few years since has been in a manner revived during the last year, by the proposed employment of some of the articles suggested as a Substitute for Cotton, the pressure of which has somewhat dwarfed the importance of the Paper want.*

It appears that in the autumn of 1861, a specimen of paper made from common sea-wrack, by Mr. Hartnell, of the Isle of Wight, was submitted to the Editor of the *Builder*, who reported the same to be, in colour and texture, far superior to the best straw paper which the writer of this notice had ever been able to obtain for writing purposes. Into the question of relative cost and ultimate price the Editor did not enter; but *Zostera marina*, or sea-wrack, is said particularly to abound on the coasts of the Isle of Wight.

* Inventors have for many generations tried their skill in making paper from the fibres of plants easily and cheaply obtained. About 1770, one Jacob Christian Schaffer, a pastor at Ratisbon, produced a little volume of sixty leaves, all made of different substances. Among them were the bark of the willow, the beech, the aspen, the hawthorn, the linden, and the mulberry; the down of the catkins of the black poplar; the silky down of the asclepias; the tendrils of the vine; the stalks of the nettle, the mugworts, and the dyer's weed; wood-shavings, saw-dust, potatoes, and fir-cones; and numerous varieties of leaves, stalks, reeds, straw, moss, and lichen. On every leaf a portion of description was printed. A copy of this curious book will be found in the British Museum. Later in the century, a French Marquis printed a small volume of his own poems on paper derived from some of those unusual sources; and, as was sarcastically observed, "the paper was worthy of the poetry."

The paper made from it is like straw paper, and hence not very white in colour, and more like India paper in that respect; but perhaps great improvements in the bleaching may yet be effected in the manufacture of such paper.

This announcement was also followed up by a communication to the *Builder* from Mr. C. M. Archer, stating that in 1855, following upon another invention for re-manufacturing printed and waste paper into pulp and paper again, Mr. Archer produced (as was shown by an enclosed specification) *fibre* and paper pulp from sea-weed.

Mr. Archer has supplemented this claim by a communication to the *Star* of Sept. 22nd, 1862, stating that so long since as November, 1855, he, "then residing at Haverstock-hill, after the usual labour, experiment, and expense, received provisional protection and specification No. 2696, November 29th, 1855, from the Commissioners of Patents, *for the 'production of fibre* and paper pulp from sea-weed, *and for the production of textile fabrics from the same.*'"

Upon this, the Editor of the *Builder* remarks:—"As regards Mr. Archer, we admit it may be a question whether his 'sea-weed' be identical with, or include, sea-grass, sea-wrack, *Zostera marina;* which, by some authorities, is said, expressly, not to belong to sea-weeds, though commonly believed to be of that family of plants. However this may be, it now appears, from an authorized disclosure made in an official report, by a committee of inquiry, respecting the proposed substitute for Cotton of which a City man was said to possess the secret; that this gentleman, Mr. Harben, of Haverstock-hill, 'desires now to state, for the information of the public, that his discovery is the applicability of the fibres of the marine plant known as *Zostera marina*, or common grass-wrack, for manufacturing or other purposes.' It thus appears that the proposed substitute for cotton as a fibrous material for textile fabrics is one and the same thing with that proposed in the *Builder* of the 16th of October last, by Mr. Hartnell, of the Isle of Wight, as a substitute for the rags of such fabrics, in the formation of paper; if it be not also one and the same with that proposed in our following issue by Mr. Archer, of Haverstock-hill, for fibre or the textile fabrics themselves."

Mr. Harben has freely given his "discovery" to the public; and he proposes that the idle cotton-spinners should be at once sent to the sea-side to collect the material; and that for the future its cultivation be promoted everywhere around our coasts and islands. Abundance of it already exists, it seems, in the Mediterranean, as well as on our own coasts.

If its fibres be classable with woody fibres, however, as so many of the proposed substitutes for cotton are said to be, the result may not be so important as has been anticipated. "A Medallist in Botany," writing to the *Morning Post* on substitutes for cotton, says:—

"I have obtained samples of most of the fibres proposed, and I have sub-

mitted them to careful examination under the microscope. I find them all to be varieties of woody fibre, more or less split up and divided, varying in the length and thickness of the *fibrillæ*. The fibres of all the specimens I have seen are, nevertheless, uniform in the following particulars:—They are all solid and inelastic, or brittle, with joints and rough edges, showing where the bundles of *fibrillæ* have been torn apart. Having some practical acquaintance with cotton-spinning and weaving, I assert that the above qualities render woody fibre unfitted to be used as a substitute for cotton without a considerable modification of our machinery. The fibres which have been exhibited may probably be useful as substitutes for linen, if they can be largely produced at a cheap rate; but the woody fibre (from which all the proposed substitutes, I feel confident, are drawn) can never be a perfect substitute for cotton, which consists of vegetable hairs, hollow, elastic, ribbon-shaped, and spiral, with smooth edges and surfaces. If we want a substitute for cotton, we must not look for it in woody fibre."

Mr. Harben, however, has examined h's weed with the microscope; and he is so sanguine himself of its value, that he believes, from its strength, elasticity, and silky texture, it will be more likely to supersede than substitute the use of cotton. A deputation of gentlemen connected with Manchester and London firms next presented a memorandum to Mr. Harben, certifying that in their opinion the fibre within the outer sheath of the sea-grass is available for extensive use in manufactures; that its flexibility, its docile nature, its length, strength, and beauty, satisfy them that it is worthy of the most careful study of practical men.

We abridge the following details of the *Zostera* from the *Manchester Guardian*:—

"This plant takes its name from the Greek word zoster, signifying a ribbon, from the shape of the leaves, which resemble a long narrow tape, and often reach a length of from three to four feet. The plant is not a sea-weed, yet it resembles sea-weeds, and lives among them. To botanists the zostera is interesting from the exceptional character of its flowers, and from its mode of reproduction, which is totally different from all that is known of other flowering plants, and the manner in which fertilization takes place among these plants is unknown. The home of the zostera is the bottom of the ocean, and it is found from the North Sea to the Mediterranean, in the Indian Ocean, and on the Arabian coasts. The Zostera marina, or grass-wrack, is a British species, and is used as a common material for packing, and for stuffing cottagers' cushions and beds. It has also been used medicinally as a poultice for tumours, not, however for its own sake, but chiefly for the iodine of the seaweeds that are gathered with it. Botanists have differed in their judgment as to the order to which the plant belongs. Paxton places it among the fluviales. Lindley reckons it as forming an order by itself, which he calls Zosteraceæ. In the botanical department of the museum at Kew it is exhibited as a member of the lily order (Liliaceæ), and its bulbous root favours this arrangement. The grass-wrack is therefore shelved at Kew in close neighbourhood (as a member of the same family) with the bowstring hemp—fibre well adapted for cordage, obtained from the leaves of an Indian plant; with New Zealand flax; and with those branches of the palm family from whose leaves Panama hats are made. The handbook to the museums of Economic Botany says of the grass-wrack that it is common on the British coast and in most parts of the world, near low-water mark. It is also common in salt water ditches, and flowers in August and September. The production of fibre from the leaves of the Zostera marina is no novelty. It has often been included in patents for paper-making and for other useful purposes.

"A patent for sea-weed had been obtained in San Francisco, previously to Mr. Archer's discovery. Neither of these was proceeded with; the true algæ in fact, having no fibres in their structure, would appear to be singularly

inappropriate for the strength required in paper. Hartnell's patent for application of the grass-wrack to the manufacture of pulp for paper, to be used alone or in combination with other fibrous materials, appears more practicable, as this plant is not one of the algæ, and it does contain fibre resembling the grasses."

Attention continues to be directed to the question. One objection urged against it is that, whatever may be the quantity of the fibre obtained, the carriage of the refuse will prove a serious item of expense; but, in reply, Mr. Harben pointed out that although for the purposes of the first experiments the grass must be taken to the mills, ultimately the machine for desiccation must be taken to the grass. "America," he remarks, "does not send the whole cotton tree, but merely the part usable in manufactures." Should the plant be found available, it will always have one recommendation not common to any other material—namely, that it can be obtained indifferently from every shore. Messrs. Koning and Co., of Texel, Holland, write that *Zostera marina* has been dealt in by them for some time, that it grows extensively on the Zuyder Zee, and that the collecting of it gives employment to many poor people. The grass is cut twice a year, and they have in existence a systematic mode of operations. Some traders in this country have been in the habit of obtaining it from the Baltic.

Among the other substitutes proposed are the following:—

Mr. F. Fenton, of Mappleton, near Ashbourne, in Derbyshire, has shown samples of a new fibre cotton, patented by him, and prepared from flax, hemp, jute, China grass, bark fibre, and tow. The cost of preparation, he says, is about one farthing a pound; and the article, which is said to equal Sea Island cotton, can be sold at from 3d. to 6d. a pound, leaving a profit. The price of cotton has been 6d. a pound.

Mr. David Chadwick, of Manchester, describes a discovery by a foreigner of a new fibre, to be had in unlimited quantities and at a reasonable price, to be worked either alone or mixed with wool, flax, silk, cotton, or alpaca, and which takes all dye colours.

The *Nord* speaks of another discovery in a plant which abounds in Africa and America, and will thrive in Algeria: and a company is being formed at Paris, on a large scale, to manufacture cotton from this plant.

As to all substitutes, however, practical men in Lancashire say that they must be converted into yarn twist and goods bleached, dyed, and washed, before their real value can be pronounced upon.

At the Society of Arts, the secretary (Mr. Foster) states that he has received from Mr. W. T. Keates, the chemist, of Chatham-place, Blackfriars, sent to him by Mr. Ghislin, of the Cape Colony, specimens of South African bulbs which, on being treated, he found to be full of fibre, and well adapted for textile and paper purposes. More recently he had received from

Mr. Ghislin other plants of the same family, which yielded a much superior fibre, similar to a soft elastic silk—not spiral, but twisted like a bell-pull. He was informed by Mr. Ghislin that these plants were indigenous to the wastes of South Africa, and that they could be so easily cultivated that any quantity could be produced. A glass jar containing half stuff for paper-making, and a variety of prepared specimens, plain and dyed, were laid on the table.

Dr. Collyer has perfected a process, under which he claims that one ton of "half-stuff," worth 26*l.*, can be produced for from 12*l.* to 16*l.*, according to the material used, which may be wheat or oat straw, flax waste, Indian corn stalks and leaves, refuse sugar cane, &c.

Excitement continuing to increase in the market for the various products to which attention had been turned owing to the scarcity of cotton—flax, hemp, and jute, all experienced great advances in prices. In jute, a rise of about 8*l.* per ton, or more than 25 per cent. took place upon that current a week back. The movement was greatly accelerated by a statement that Messrs. Thomson and Co., of Sleafield Works, Dundee, had introduced a method for its treatment which will enable jute to be spun on cotton machinery, and, in fact, to fulfil in a great degree the purposes of that staple. The rapidity with which the preparation can be effected is stated to be very great—the entire process requiring only a few hours, and the material produced is also such as will be applicable for admixture with wool and silk. Meanwhile, however, some experienced persons are disposed to doubt if it will not be found too brittle. At the same time a number of other persons put forth suggestions and claims, and a certain kind of Italian grass was spoken of as a desirable product. Should jute, however, prove really available to the extent anticipated by Messrs. Thomson, it will be likely to take the lead of all other articles, owing to the great abundance in which it can be obtained. About ten or fifteen years ago it was scarcely known as an article of commerce, but the quantity now annually exported from India is thought to be about 70,000 or 80,000 tons. It comes principally from the eastern parts of Bengal, and is very easy to cultivate. The first purpose to which it was applied on a large scale was the manufacture of gunny bags, and subsequently it has been introduced for the manufacture of carpets, which have been used in considerable quantities in America. Several cotton-spinners state that jute prepared in the old form has been for some time mixed with cotton to make the commoner form of cloths. All admit that the jute now shown is far better adapted for use, and that by being made with the fibre or staple shorter it can readily be mixed and spun in the cotton machinery. As regards mixing with wool, there seems to be no difference of opinion whatever on the adaptability of the material. One broker said it may be sold as a coarse form of wool, so much does it resemble it in appearance.

Meanwhile, considerable attention has been paid to extending the culture of cotton in various parts of the world. "New companies have been started for the purpose of promoting the growth of cotton in India, Jamaica, and Africa; and other companies are likely to be established for producing the article in Algeria, in Turkey, and other places. In fact, there is scarcely a warm part of the world where cotton may not be obtained in abundance. A Correspondent states that cotton grows spontaneously in Cochin-China, and that it is in the power of France to obtain from that region sufficient of the commodity to render her independent of foreign supply. It appears that the growth of the cotton is not confined to merely one province, but that the entire country is suited to its production. The cotton grown in Cochin-China is said to be soft and silky; and though but little attention has hitherto been devoted to its cultivation, it rivals in quality the produce of New Orleans. After a two years' war, Cochin-China has alone exported 2,000,000 lbs. weight of cotton.

"We have been induced to look at India as the principal field from which we might obtain cotton supplies. But what good are a productive soil and industrious hands if the means of transport be wanting? Mr. Haywood, who was sent to India by this association, says that no doubt India is capable of supplying from 4,000,000 to 5,000,000 bales of cotton annually; and that, had land and water communications been more extensively opened throughout the country, our present imports from thence would by this time have been doubled; that the rapid completion of railway will prove of enormous advantage, by hastening the establishment of European agencies in the interior; that branch feeders, whether railways or roads, will be required to connect the main lines with the remoter districts: and that more bridges are required, the construction of which would save thousands of miles of circuitous traffic. In fact, India wants the civil engineer and capitalist more than the cotton cultivator. The capacity is there to supply our wants, but the means of bringing the produced article must also be supplied. In this important crisis of our national history we are sorry to find that the government has not done more to promote productive works in India. Much blame is deservedly fixed on Sir Charles Wood, for his wooden-headed resistance to all improvement." These are hard-hitting words, but they are true; and the public dissatisfaction with this minister has been unmistakeably shown by a public meeting at Manchester, calling for his dismissal. It is really grievous to see the staple interests of the country confided to such heads.

NEW PROCESS FOR THE PRESERVATION OF MEATS.

M. Martin de Lignac has patented a new process for the Preservation of Meats. He maintains, that by the usual mode of placing meat first in salt and then in pickle, the salt absorbs the liquids in proportion as they separate from the flesh, then the pickle penetrates by endosmose, and preserves them from any sub-

sequent alteration by its antiseptic properties. But in this case, the salt acts on the surface a long time before it penetrates to the centre, whence results an excess of salt at the surface, whilst the centre is not sufficiently salted, and still contains the principles of fermentation. If, to avoid this, the meat be cut up, the salt in contact with large surfaces absorbs too largely the liquids contained in the flesh, and extracts from them the aroma and a portion of their nutritive juices. M. de Lignac's process ensures uniform salting, as follows:—If it be a ham, he introduces between the bone and the muscle at the small end a sound, which is attached to a stop-cock which communicates by a tube with a reservoir of water saturated with salt, to which are added various aromatics and condiments. The reservoir is from 25 to 35 feet high. When the stop-cock is opened, the liquid by its pressure rapidly separates the muscle, and the two or three ounces of pickle which are necessary for the preparation of one pound of meat, are easily lodged in the cellular tissue which surrounds the bone. Thence it forms a kind of reservoir, the liquid spreads, penetrating all the fibres by infiltration, distributing regularly and homogeneously the conservative agent, and producing its first effect upon the part most susceptible of alteration, that which surrounds the bone. The ham, thus prepared, is put for some days in a pickle-bath, to prevent by its pressure the issue of the liquid injected; besides which it completes the process by saturating the surface. The hams are then exposed to a current of air at a moderate temperature. When, by evaporation, they have lost the infiltrated liquid and 5 per cent. of their normal weight, they are smoked for a time which varies with their weight.

CLEANING AND PRESERVATION OF ENGRAVINGS.

Dr. A. A. Hayes, in the *Scientific American*, gives the following directions for Cleaning Prints:—

In commencing to restore an engraving some attention must be given to the kind of injury it has suffered. A general brown colour, more or less deep, resulting from atmospheric action only, is the least possible change. Spots and stains caused by ink, coloured fluids, oil, or insects, must be first treated and all pencil marks removed by india-rubber or bread crumbs. A fluid acid, obtained by dissolving one ounce of crystals of oxalic acid in one-fourth of a pint of warm water, may be used for application to all stains, and the paper should be wet with it thoroughly where spots of any kind exist. Excepting in a few cases, this acid will not cause the removal of stains immediately, but generally it combines with the bases of them, and they are removed by subsequent steps: the thorough wetting should be done a few hours before proceeding to clean the engraving.

To facilitate handling and for the protection of the edges of the paper, a piece of millinet, or the stiff open fabric formerly sold for ladies' skirts, should be roughly sewed around one stick at each end, so as to form an apron, like a chart attached to two rollers, the cloth of which must be an inch larger than the largest print to be handled. From one to ten prints of even large size may be cleaned at one time, after they have been wet on their spotted parts with the acid, and evenly spread on the apron, so as to allow of the immersion of the whole in water. A tub of the ordinary size will allow prints of considerable surface to become immersed, but the most desirable resort is a common bathing vessel, so nearly filled with warm water that the bent paper

supported by the open texture can rest on the bottom and sides, where it should be allowed to remain with occasional raising of it, and moving it by means of the stick handles, from twelve to twenty-four hours.

To explain this apparently rough treatment, it must be recollected that paper is a firmly felted mass of short fibres which may be soaked in various fluids for weeks and resist all diluted acids and most chemical agents for a long time wet, if not exposed to mechanical abrasion by touch or rapid motion. The strong paper of engravings absorbs much air, which resists the penetration of the water, and motion is necessary to remove this as well as to allow the coloured solutions formed to pass away. This motion may be given by holding the supporting sticks and passing the mass from end to end of the bath, or slowly up and quickly down, enabling the sheets to become separated momentarily. Discoloured water may be drawn off, the apron and contents resting on the bottom and sides, and fresh water be slowly admitted to replace it. Cold water can be substituted for warm, longer time being allowed for its action. When the prints no longer add colour to the water after being agitated, the water must be withdrawn, and replaced by such a portion as will barely cover the paper. Half a pound of bleaching powder (chloride of lime) mixed to a paste first in cold water, and then added to two quarts of cold water and well stirred from time to time for six hours, will afford a nearly clear fluid resting on a white deposit in the earthenware vessel. A portion of the clear part of this fluid must be added to the water in the bath, until both taste and odour denote the presence of chlorine in the water. Motion being given to the paper the bleaching effect of chlorine will be perceived, or its odour in the water will have been lost; when more must be added so that the odour or taste of chlorine must be present in the water two or three hours.

The action of the chlorine on the parts previously wet with the acid will remove nearly every kind of discoloration, while the brown hue of the paper giving place to perfect whiteness, the light and shadows of the engraving become of their original perfectness, and the picture will be as distinct as when it was first impressed. It has happened, in a few trials, when the prints were long stained they did not yield to the weak chlorine water, that resort was had to a little mineral acid to develop free chlorine in the bath. One ounce of muriatic acid was added to one pint of cold water, and the weak acid thus formed mixed in the water of the bath, soon caused the bleaching of every fibre in the paper.

After the bleaching the water must be drawn off, the paper drained, fresh clear water admitted, and the paper moved through the water to thoroughly wash away all adhering chlorine. Several quantities of water may be used, the paper being each time drained; and finally the whole mass, raised by the handles, may be placed on a clean white wood table or board to drain. If a number of prints have been treated, the wet mass may be placed in a warm room, or air may be admitted, and as the one on the top of the pile becomes more dry than the rest, it may be removed to any support and left to dry. To hasten the drying extend ordinary bed sheets and spread the wet prints singly on these; slow drying rendering any pressing unnecessary.

Those having the usual presses might prefer to press the still damp sheets, and where only two or three prints are the subjects of trial, the substitution of other vessels and ready appliances will occur to any one.—*Quoted in the Mechanics' Magazine.*

CONSOLIDATED EMERY WHEELS.

These Wheels, manufactured by Warne and Co., are intended as a substitute for and an improvement on the ordinary leather emery wheel—used for polishing iron work—more especially case-hardened work. In an experiment with two kinds of wheels, one of which was a small disk composed of vulcanized india-rubber and emery, and the other composed of oxidized oil and emery,—the latter was superior. Oxidized oil, a newly-invented substance, bids fair to become of considerable value. In the present instance there can be no doubt of its utility. We are informed that wheels composed of vulcanite and emery are equally

effective for cutting, grinding, and polishing iron or steel of any description. They are mounted on spindles in the same manner as grindstones or other grinding wheels.—*Mechanics' Magazine.*

PATENT "MARETZO."

Mr. E. J. Bridell has patented "Improvements in the manufacture of substances artificially coloured, veined, or mottled, like marbles or other substances." In carrying out this invention the patentee employs in the production of the artificial substances made according to this invention, and which he calls Maretzo, cements and other similar materials: by preference a cement or material that will form a hard compact substance, and afford a smooth surface capable of receiving a polish may be employed. According to the colours of the veins or figures required to be imparted to the artificial substance, corresponding colours are mixed with the requisite amount of liquid in flat trays made shallow, in which are spread fibres of floss silk or silk waste, or other fibrous materials which will rapidly absorb the colouring matters, and readily impart the same to the substances treated as hereinafter described. The silk or other suitable material is fixed in the form of the veining or figure required by means of light frames of various sizes made of wood or wire, or the material may be also used at times without such frames. The silk is well saturated in the before-named trays of colour, and is then spread open with suitable instruments; and it is afterwards carefully taken up and laid, with or without a frame, upon a piece of glass, either flat or curved, as may be required, or upon some other smooth or polished surface made of suitable form, such as metal or plaster. When it is required to give a varied appearance to the substance, patches of suitable coloured cement are laid upon the glass: a layer of suitable coloured or tinted cement is then superadded. The cement is carefully spread, so as to be about one-eighth of an inch thick; and, after being allowed to remain a sufficient time to allow the saturated silk to part with its colour or colours, the silk fibres are removed either by raising the frames, or by using suitable instruments. The glass or other smooth surface is then shaken or agitated, so as to blend or harmonize the colours, and a light coat of dry cement is sifted on for the purpose of extracting the superfluous water, and is afterwards gently removed by a plasterer's trowel. The material so prepared is then smoothed or trowelled all over, so as to form a slab or other required form. To consolidate and strengthen the slab he employs a backing of canvas, or other suitable fabric, which he applies to the slab.—*Builder.*

COAL AND IRON OF SOUTH YORKSHIRE.

A paper has been read to the Institution of Mechanical Engineers, at Birmingham, "On the Coal and Iron Mining of South Yorkshire," by Mr. Parkin Jeffcock, of Derby; giving a description of the geological nature of the district, and of the position and extent

of the principal seams of coal and beds of ironstone, with a statement of the localities where each are mostly worked. The South Yorkshire coalfield forms the continuation northwards of the Derbyshire coalfield, the principal coal seams being clearly identified with corresponding seams in Derbyshire. The two most important seams are the Barnsley Thick coal of about nine feet thickness, and the Silkstone of about five feet thickness: the former is a fine steam coal, and is the same seam as the Top Hard coal of Derbyshire, worked at Staveley and elsewhere; and the latter is an excellent household coal, and the same seam as the Blackshale coal of Derbyshire. The ordinary modes of working the coal in the district were described, all of which are more or less defective, requiring a large amount of the coal to be left in the mine for supporting the roof during the working: and at some collieries these are now abandoned for the superior "long wall" system, in which the coal is worked in a single face of great length, and the whole of the coal is got out at one operation, the roof being supported immediately behind the working face by timber props or by pillars built up of the rock, and in some cases cast-iron puncheons or props are now used, of which a full-size model was exhibited. The ventilation of the mine is also considerably simplified in the "long wall" system. The quantity of water met with in the district is in general not large, and there are few collieries where large pumping engines are required; but the coal seams are of a very fiery character, evolving great quantities of inflammable gas, and the greatest precautions are necessary to prevent explosions. The most terrible explosions have taken place in the Barnsley Thick coal, the most important seam of the district; this and the Silkstone seam being specially liable to sudden and powerful emissions of gas. In most of the collieries safety lamps are now used exclusively; and the ventilation being produced by a furnace at the bottom of the upcast shaft, the air from the mine is conveyed into the shaft by a separate passage or "dumb drift," so as not to pass through the fire of the furnace, which is supplied with nothing but pure air direct from the downcast shaft. At some of the mines near Barnsley large fans driven by steam-power are employed, which form a simple and efficient means of mechanical ventilation, and have worked continuously with complete success for several years.

ARTESIAN WELLS.

MR. G. B. BURNELL has read to the Society of Arts, an able paper on recently executed Deep Wells and Borings; having especial reference to the doubtful success of Artesian Wells, excepting under particular circumstances. Mr. Burnell, after detailing the attempts at Southampton, Calais, Kentish-town, and Harwich, concludes as follows:—

Now there may be drawn from these unexpected results of the deep borings in the tertiaries of what may be specially named the

London basin some valuable scientific, and practical conclusions. These may be briefly stated as follows:—1st. That, at present, geology is only so far advanced as to enable us to state with tolerable certainty what we shall *not* find under the surface, but by no means to justify any positive assertion as to what we *shall* find; thus, knowing that the London clay is on the surface, we may be certain that the crag will not be found beneath it; but it by no means follows that necessarily the chalk, the lower green sands, the oolites, or the usually subordinate strata should be there. 2nd. That the first attempt to sink an artesian well through a previously untried stratum is at all times a hazardous experiment; and that it is, therefore, one which should never be tried by those who only work with the money raised by forced taxation. It was upon the latter ground that Mr. Ranger very properly recommended the town of Southampton to stop the philosophical experiment upon which they had already incurred so large an outlay; and it is certainly wiser to leave the solution of these problems to municipalities possessed of private resources, or to private enterprise, than to expend upon them the money wrung from the ratepayers. 3rd. And, possibly, this may be the most important conclusion of all: it would appear to be proved by the occurrence of the earlier strata in the geological series at Calais, Kentish-town, Harwich, and if I be not mistaken, at Ostend also, that Mr. Godwin Austin's theory of an upheaval of the carboniferous series existing between its extremity on the French coast and its reappearance in the Bristol and South Wales coal-field is correct. A full discussion of this important inquiry would be misplaced in this paper; but I cannot refrain from repeating what I myself have said before; viz., that, from all that is at present known, it would be more rational to seek for coal under London than for soft water. At the same time I would carefully guard myself against any appearance of encouraging an attempt of the former description, unless it were distinctly undertaken as a speculation, with great, nay, almost infallible, chances of loss.

RECLAMATION OF LAND FROM THE SEA.

MR. JOHN PATON has read to the Institution of Civil Engineers a paper "On the Sea Dykes of Slesvig and Holstein," in concluding which he reviewed the general advantages of these works in England, Holland, and Denmark, and the results which had already been accomplished, as well as those which still remain to be achieved. He considered the true test of successful engineering enterprises to be, not so much the perfection of the gigantic works which had been raised up as monuments of skill, but rather the benefits they conferred upon the world. Judged by this standard, it was contended that no other engineering works were of more paramount importance than reclamations from the sea. It was observed that the country, which was originally a trackless waste, now consisted of some of the richest land in Europe; fur-

nishing, together with the kingdom of Denmark, corn to England to an extent only surpassed by two other great states of the world; besides vast numbers of cattle, sheep, and horses. These results were then compared with what had been accomplished in the Lincolnshire fens and in Holland, and it was remarked that the three marsh countries were capable of affording a larger supply of grain than was now imported from America, Russia, and Prussia combined. Indeed, independently of other great enclosure works, it was estimated that the annual revenue of those countries was at least eight millions sterling; a sum equivalent to more than the net passenger receipts of all the railways in the United Kingdom. There were still upwards of 600,000 acres of land in England and Ireland, worth from 20*l*. to 60*l*. per acre, which might yet be reclaimed: and if similar districts in other countries were added to this calculation, the magnitude of the results could scarcely be overrated. It was remarkable that, notwithstanding the many advantanges attending reclamation works, which could now be effected at a less expenditure than formerly, by the judicious application of steam-power, such enterprises were still regarded with suspicion and distrust, although they afforded the means of the soundest and most profitable application of capital. Other papers upon this important subject were read by Mr. James Oldham and Mr. J. H. Muller, of the Hague.

CENTRIFUGAL PUMPS.

The successive improvements which may be traced through the class of water-wheels as chief motors in transmitting power, in which the modern turbines are conspicuous, have also suggested a reverse action, by which the wheels and turbines are changed into Pumps, of which many different patterns are now and have long been in use, operating as suction and force lift pumps.

The laws of maximum useful effect, which have been very fully and clearly demonstrated for water-wheels, as types, apply to their reversed patterns, as to the form and arrangement of the blades, experiment having demonstrated a large increase of the discharge with a change from ordinary radial to properly curved arms, without increase of power. The following abstract of an experiment by Col. Morin, made at the Great London Exhibition, illustrates this point:—

Form.	Revolutions per minute.	Gals. raised per minute.	Height raised.	Useful Effect.
Curved Vanes (Appold's)	792	1164	18 ft. 8 in.	·649
" " "	788	1236	19 4	·680
Inclined " (45 deg.)	694	560	18	·394
" " "	690	736	18	·434
Radial "	624	369	18	·232
" "	720	474	18	·243

With the best form of pump which can be devised, useful effect is controlled by velocity and lift, and the value of this motor is confined to low lifts under excessive speeds. Experiments made on Appold's centrifugal pump show a progressive per centage of work done, under a lift of 5·5 ft., with a 12-in. pump, of 21·2 per cent. for 375 revolutions, 59·1 for 400, 71·9 for 495, an increase to 607 revolutions giving 69·2 per cent. To raise water 67·66 ft. required a speed of 1322 revolutions; and within their special range of application, 70 per cent. useful effect is all that can be claimed for the best motors of this class.

The laws of form, however, have been much overlooked in those in ordinary use, radial blades being common in practice. For baling large quantities of water from foundations in excavation, where the supply carries much sand and gravel, for wrecking pumps, and like uses, the facility with which dirt, gravel, grain, &c., are passed through these pumps, is a strong point in their favour, while they have no claim to merit on the ground of economy in power.

About ten years ago, some of our scientific journals were agitated by a discussion on the merits of a new theory of centrifugal power, which proposed to regenerate the mechanical world, and overthrow the antiquated notion that a machine could not transmit more power than was imparted to it. It was claimed to be demonstrated at the end of much printing, and was admitted by some of our puzzled savans, that by certain mechanical adjustments an increase of velocity might generate a force of 173,824 foot-pounds from a power of 42,480, and twice the velocity would yield 695,296 foot-pounds for 84,960. But like all wonderful discoveries of the kind, which seem to lead a cometary life, it has vanished in silence from the horizon of mechanical science, to return no more, and to be numbered among the steam and cloud engines, caloric steamers, water gasometers, full steam cylinders, and other celebrities of the passing hour.

From the pertinacity with which some of our engine-builders have urged the necessity of an equable motion in pumping, we have been somewhat surprised to see so much neglect shown to the rotary pump, which accomplishes their desideratum in the most perfect manner, and the fact of such neglect must be taken as a strong argument against the reliability and economy of this motor.—*Journal of the Franklin Institute.*

RAILWAY TRAVELLING, AND WORKING EXPENSES.

THE number of Travellers by Railway in the United Kingdom in 1861 was 163,435,678, besides 47,894 holders of season and periodical tickets, who must have made very many journeys; in the whole, there must have been much nearer six than five journeys in the year for every soul in the kingdom. The trains, passenger and goods trains together, travelled 102,243,692 miles, which is further

than going 4000 times round the world; 267,134 horses and 357,474 dogs made railway journeys, little to their liking. The goods traffic comprised 12,083,503 cattle, sheep, and pigs, and 89,857,719 tons of minerals and general merchandise. In these vast piles of property conveyed from place to place the minerals double the general merchandise in quantity, and they are carried at little more than a quarter of the cost; 60,386,788 tons of minerals produced to the railway companies only 4,951,899*l.*; while 29,470,931 tons of general merchandise brought them 9,157,987*l.* The receipts of the railways (10,433 miles in length at the close of the year) from all sources of traffic were 27,766,622*l.*, of which 13,085,756*l.* came from passenger traffic and the mails, and the residue from goods. The expenditure was 13,187,368*l.*, or 47 per cent., leaving rather more than 14,500,000*l.* net receipts. The compensation paid for accidents and losses amounted to 181,170*l.* The quantity of rolling stock was no less than 5801 locomotives, 15,076 passenger carriages, and 180,574 waggons for goods traffic; in all 201,451 engines and carriages. The numbers are enormous, and they are enormously increasing. Comparing last year with the year before, notwithstanding the bad weather, the passengers increased by 13,600,000, the minerals by 8,600,000 tons, the receipts by above 2,000,000*l.*, the miles travelled by trains nearly 9,000,000. 3,896,960 trains ran in the course of the year 1860; upwards of 10,000 a day.—*Express.*

The whole sum paid as Working Expenses on Railways in the United Kingdom amounted in 1861, to 13,843,337*l.*, as compared with 13,187,368*l.* in 1860. The receipts were 28,534,633*l.* last year, as compared with 27,748,486*l.* in 1860; and the proportion of working expenses to revenue rose consequently to 48 per cent. last year, as compared with 47 per cent. in 1860, the net receipts having only advanced from 14,561,118*l.* in 1860, to 14,691,296*l.* in 1861. The proportion of working expenses to revenue was in England and Wales last year, 49 per cent., as compared with 48 per cent. in 1860; in Scotland, 45 per cent., as compared with 44 per cent. in 1860; and in Ireland, 44 per cent., as compared with 45 per cent., in 1860. Thus while the railway management of England, Wales, and Scotland appears to have retrograded, that of Ireland has improved. Taking the United Kingdom generally, the charge for maintenance of way amounted last year to 18·37 per cent. of the whole working expenses, as compared with 18·48 per cent. in 1860; the charge for locomotive power was 28·44 per cent. of the whole working expenses last year, as compared with 28·83 per cent. in 1860; the charge for repairs and renewals of plant was last year 8·94 per cent. of the whole working expenses, as compared with 8·49 per cent. in 1860; the traffic charges (coaching and merchandise) were 27·94 per cent. of the whole working expenses last year, as compared with 28·05 per cent. in 1860; the charge for rates and taxes was 3·94 per cent. of the whole working expenses last year, as compared with 3·93 per cent. in 1860; the charge for Government duty was 2·62 per

cent. of the whole working expenses last year, as compared with 2·75 per cent. in 1860; the charge for compensation for injuries to passengers was 0·98 per cent. of the whole working expenses last year, as compared with 1·37 per cent. in 1860; the charge for compensation for damage and loss of goods was 0·44 per cent. of the whole working expenses last year (in 1860 no similar analysis appears to have been instituted); the legal and Parliamentary expenses were 1·58 per cent. of the whole working expenses last year (in 1860 no similar analysis appears to have been instituted); and the miscellaneous charges not otherwise particularized were 6·75 per cent. of the working expenses last year, as compared with 8·10 per cent. in 1860.

PEAT IN METALLURGY.

A PAPER of considerable interest and importance appeared in the *Times* journal, upon the distinct varieties of fuel—Peat and Coal—of which several specimens were shown in the recent International Exhibition. Not much was to be learnt from the display of mere lumps of raw peat, yet there were several illustrations connected with peat of great practical value. There is only one metallurgical process in Great Britain in which, so far as we are aware, peat is directly applied as fuel, and in that only partially—namely, the smelting of lead in the "ore-hearth." This method is extensively employed in the North, and in the case of rich ores is maintained by some experienced smelters to be superior to every other. It is a singular circumstance that in former times it was practised successfully in Derbyshire, where it became extinct; and that attempts to reintroduce it have signally failed.

Numerous attempts have been made to render peat more generally available as a fuel, both in this country and on the Continent; and the records of trials which have been published on the subject are not a little conflicting. All attempts hitherto made to render peat suitable as a fuel for metallurgical purposes have had reference either to its condensation, by compression or otherwise, or to its carbonization. In order to effect the compression of peat numerous contrivances have been devised, and, as usual, patented; and at the present time much attention is directed to the compression of peat. The peat is reduced to pulp in a sort of pug-mill or other suitable machinery, and is afterwards drained and moulded into brick-shaped pieces, either with or without pressure. The peat thus acquires great solidity and a much higher specific gravity. But this treatment is necessarily so expensive as to render its adoption impossible where coal abounds. In some countries, however, such as Sweden and Bavaria, it is practised with success. In Bavaria peat bricks are extensively used under locomotive boilers; and in Sweden, Ekman has long employed peat in his gas-welding or re-heating furnaces; it is fashioned into bricks, and subsequently dried by artificial heat at a temperature almost sufficient to cause incipient charring. In

the Swedish Department were specimens of iron manufactured in such furnaces, with prepared peat as the fuel, by Baron Hamilton, Nericia, at whose works the annual consumption of peat for this purpose is between 600 and 700 tons. In the Italian Department, Gregorini exhibited steel made in a gas-puddling furnace with peat and lignite as fuel. Furnaces constructed on this principle, whether for the use of peat or other kinds of fuel, are well worthy the attention of our ironmasters and other practical metallurgists who are interested in economizing fuel.

We have a belief, which has grown with the experience of years, that these furnaces will one day—and that not far distant—play an important part in the metallurgy of this country. They may be thus briefly described. Instead of the usual fire-place in the common reverberatory furnace, there is the "gas generator," consisting of a circular chamber of fire-brick several feet deep and two or three feet in diameter, closed at the bottom, and having a hopper at the top, through which fuel is supplied. This chamber, at a certain height from the bottom, is in direct connexion with the body of the furnace, so that flame may issue as freely from it as from the fire-place of an ordinary reverberatory furnace. In the sides of the generator, at a certain distance from the top, is a series of three or four small round holes on the same level, and at some distance lower down is another similar series of round holes. These holes are for the passage of the air intended to support combustion in the interior of the generator, which is blown in either by a fan or some other convenient blowing machine. Now, when the generator is full of incandescent fuel, and air is injected through the lateral holes, carbonic oxide gas is copiously produced and passes into the furnace, as there is no other place of egress, the hopper at the top being supposed to be shut. As it escapes from the generator, it is met with a current of heated air, or, as it is technically termed, "hot blast," which is injected downwards from the roof of the furnace at or near its junction with the generator, either in several jets or in one continuous sheet. The carbonic oxide while still hot is thus burnt, and the heat developed is sufficiently intense even to melt wrought-iron by the hundredweight. The air which supplies the generator is also previously heated; and in the Swedish furnaces the apparatus for heating the blast consists of a series of cast-iron pipes fixed at the lower part of the stack. Hence only the waste heat of the furnace is employed for this purpose. It is usual to place a hollow cylinder of iron round the generator, so as to leave a closed space between its internal surface and the exterior of the generator; and into this space the hot blast is introduced, whence it passes through the two rows of holes previously described into the interior of the generator. The atmosphere of such a furnace can be rendered either reducing or oxidizing at will by regulating the amount of blast. At the bottom of the generator is a door, by means of which the ashes or clinker from the fuel may be withdrawn. These furnaces can be so modified as to suit any kind of

fuel. We have the conviction that they would be well adapted for the free-burning coal slack of South Staffordshire and South Wales, of which enormous quantities continue to be wasted, and especially for anthracite. This kind of coal gives intense local heat, but this inconvenience might easily be remedied by introducing along with the air into the generator a certain proportion of steam. This steam would be decomposed with the formation of carbonic oxide and hydrogen gases and some carbonic acid, and a considerable reduction of temperature would be the result. But the heat thus removed from the chamber would be subsequently restored in the body of the furnace by the burning of the combustible gases derived from the decomposition of the steam, so that there would be no loss of heat, but only a transference of it from the generator, where it is not wanted, to the furnace where it is applied. The old reverberatory furnace is only a clumsy sort of gas-furnace; but in those such as we have just attempted to describe, the fuel is converted into combustible gas, which may be applied under most advantageous conditions. It would be possible to generate carbonic oxide to any extent at a cheap rate, and to lay it on to houses for use as fuel, much in the same way as coal gas is now supplied for illumination. Indeed, it is daily so applied in many of our large ironworks, and with the best results.

Many attempts have been made to substitute Peat Charcoal for Wood Charcoal in the smelting of iron; and a machine, which it was proposed to employ, might be seen in operation in the recent Exhibition. It is described as Brunton's in the official catalogue; but the attendant assured us that it was the invention of a Mr. Buckland, formerly of the Maesteg Iron Works, South Wales. It consists of a solid obtuse iron cone, having a spiral groove on its exterior, and revolving vertically within a hollow cone of iron plate perforated everywhere with small round holes just like a colander. The peat is put into the space between the solid and hollow cones, and by the revolution of the former is forced in worm-like pieces through the holes in the latter. Thus prepared it is fashioned into bricks by any convenient machine, of which one is shown in juxtaposition. The bricks are artificially dried, and portions of them which are exhibited are solid and resisting. Peat charcoal prepared from them was also shown. A series of these specimens was shown with moulded peat charcoal and various products obtained from the destructive distillation of peat. Some years ago, it may be remembered, very sanguine views were entertained and promulgated as to the great industrial advantages which were likely to accrue to Ireland by the manufacture of paraffine and other products from peat. The recent Exhibition was rich in examples of this exquisitely beautiful substance, which is delicately white, inodorous, and insipid, and which is now extensively employed as a substitute for wax in candles. It is obtained from certain varieties of coal, such as *cannel*, by distillation at a low temperature; and, though some might be pro-

duced by similar treatment of peat, yet the quantity would be very minute compared with what would be yielded by the above-mentioned varieties of coal. Attempts were actually made on a considerable scale in Ireland to manufacture this and other substances from peat; and the result was, commercially at least, unsuccessful.*

HEATING, VENTILATING, AND COOKING APPARATUS.

In a paper, written with considerable judgment and experience, in the *Builder*, No. 1022, the merits of these contrivances in the recent International Exhibition are carefully examined.

Among the forms of French Heating Apparatus shown, was that by M. Fondet, of Paris: it consists of three or four rows of square, diagonally-set iron tubes, a connecting chamber at the base, and a cylinder disposed horizontally at the top—the ends of which last are adjusted to the pipes leading to openings at the side of the chimney-piece for the escape of heated air. The apparatus is set so as to cover an opening in the hearth, at the back, which gives admission to fresh air, and also to lean forward; leaving a space of from five to six centimètres between its horizontal cylinder and the back of the decorative splayed linings of the chimney-opening. The heat of the fire and the smoke are drawn by the draught of the chimney, in zigzag course, through the spaces between the tubes; which, being thus heated, a current passes through them and into the cylinder, and thence into the room. For good ventilation, the total area of the channels supplying fresh air, and the *bouches de chaleur* should be in excess of the space between the cylinder and the linings, which is that by which vitiated air from the room has to find escape.

From the articles exhibited by Bricard and Gauthier, of Paris, we get one useful suggestion, that of a safety-screen for a fireplace, in the form of a roller-blind, the material being brass wire-gauze.

In the British Department, Baily and Sons' Grates were examples of the advanced position of the front of the grate with reference to a portion of the splays, the latter here being covered with porcelain-slabs; and of the addition of the valved opening, in the back of the grate, above the fuel, which is in addition to the opening corresponding with the old register-door, joined with it; so that the smoke-flue might be closed in summer, but with ventilation.

Benham and Sons showed a large Dog-stove Grate, set in a deep recess, lined with glazed tiles, fixed in steel framework; the hearth being also tiled. Here the radiation of heat and prominence of

* Any one who wishes to inform himself on this subject may consult a small Parliamentary blue book, with the following title:—*Report on the Nature and Products of the Process of the Destructive Distillation of Peat, considered specially with reference to its employment as a Branch of Manufacturing Industry. Made to the Right Honourable the Chief Commissioner of Woods, by the Director of the Museum of Irish Industry.* April 8, 1851.

the open fire in the field of view, are main aims. The general principle, as to the grate and splays, was equally observable in Messrs. Feetham's stoves, some of them remarkable for their ornamentation in iron.

Supposing there to be means of ventilating the room without the chimney opening, one of the Colebrookdale Company's grates of the dog-stove kind, or other pattern that would be movable, the back of the recess is formed semicircular, or segmental, and niche-headed, and is suitably decorated to serve as background. There was a form of grate exhibited by the same Company (Young's Patent) which deserves particular notice. The improvement is concisely described as an ornamental trough fixed at the lower portion of the grate, in which is placed a right and left handed screw connected with a ratchet at the side, which, together with the screw, is moved by the poker. When the fire requires feeding, the coals are deposited in the trough, and by the revolution of the screw the burning fuel is raised up and the fresh coal conveyed into the pit underneath. By this simple means, the whole of the gases given off are burned, a great saving effected, and greater heat obtained, combined with cleanliness. There were various modifications of this system in the Exhibition: some of them applied to kitchen-grates.

The writer in the *Builder* having urged the requisite distinction between roasting and cooking in an oven, remarks :—"In recent English inventions, the front of the fire being reduced, so as to be insufficient for roasting a large joint, ovens called 'roasters;' are substituted, all heated from the same fire, and a large surface of 'hot plate,' besides ordinary ovens. Heat is communicated to parts of the range by smoke-ducts, circulating round the ovens, and between them and the hot-plate, to the brick upright flue or flues, dampers being adjusted to the flue of each division of the apparatus, which joins the main flue, to allow of such division being worked separately. The recognised disadvantages of a close oven are provided against, or as supposed, by apertures, one below the oven-door, and the other near the top of the oven, generally at the back to allow of a current from the external air into the flue ; and sometimes there is a spit, or arrangement of shelves, turning, for the meat, in the oven. The main flue passes straight up from the back of the fire, covered on the face by a metal plate, and the ordinary opening of the chimney, no longer needed for the smoke, since the fire itself is covered over by its portion of 'hot plate,' is ceiled in with plate-iron ; a door, however, being provided, for escape of smoke, of steam, or for ventilation. Such is the 'kitchener,' as exhibited by numerous makers.

"In the French contrivances, on the other hand, there is a compartment arranged as a grate for roasting in front of the fire, *à la broche;* and the same appliance is a feature of the American Emigrant's stoves, which are the nearest things we have to the portable stoves (those made wholly of iron, we mean, whilst small) of the French makers."

M. Aureliani, of Paris, exhibited his *Foyer Economique.* On the

top, or hot-plate, is an oven with sloping front and valved opening into the flue, peculiar to the French cooking apparatus; and in the plate are three large apertures (with lids and rings) for boiling, one of them having an apparatus for coffee-roasting, and one smaller aperture, and a *bain-marie* with two copper vessels for sauces; in front are ovens and hot closets, and at the angle is the place for fuel (put in at the top), with two fronts, or bars for roasting, the larger place as usual, at the end. With respect to the merits of the French and English apparatus, the means of roasting are provided by the former better than in the kitchener, unless we are to consider meat cooked in an oven as the same as that *done* before the fire; which, we may add, will never be the case.

Messrs. Brown and Green, of Luton, exhibited one of the best arrangements of the "kitchener," or long range of ovens under one chimney opening, with the heat afforded by a single small fire in the centre.

Messrs. Benham showed their Apparatus, recently placed in the New Royal Infirmary, Woolwich, and which is the French system with numerous additions and improvements: it seems to be the perfection of an arrangement where economy in cooking for a large number of persons is a main consideration. The apparatus boils, roasts, stews, broils, bakes, and steams for 500 persons, and furnishes hot water to baths and lavatories, with a single fire burning about 200 pounds of coal *per day*. The baking includes that of bread. Apparatus on this plan has been fitted at the Royal Medical Benevolent College, Epsom, and at many barracks and workhouses.

Mr. Bennett, Liverpool, exhibited Dr. Arnott's Smokeless Grate, "with recent patented improvements." This grate has a movable bottom, to which is attached some arrangement of cogs, or a worm; and this is worked by a horizontal wheel, on the hearth, the rim of which, slightly projecting in face of the foot of the grate, is furnished with holes or notches, into which the end of the poker can be inserted.

The "Smokeless Grates," of different makers, will burn 24 to even 36 hours without replenishing. Jeakes's grate is stated to consume under 1 lb. of fuel per hour, without waste, and the coal of the commonest kind. It is similar in principle to Bennett's; but the upper part of the fire is less enclosed in front by bars or *grille*; and the bars and grate-front, instead of the bottom, are movable, so that by turning the handle below the mantel they can be depressed, in lieu of raising the bottom, as the fire burns: a supply of fuel is also placed in a chamber behind.

Dr. Arnott's Grate was also exhibited by Edwards and Son. Here the grate or receptacle for coal, which is very deep, holds enough for a day's consumption; instead of bars at the bottom, it has a plate, which is elevated by a screw to afford a fresh supply of coal from below, as that on the top is consumed. The

fire is kindled on the surface, and, in Mr. R. Hunt's words, "the carbonaceous matter distilled from the coals, passing through the incandescent mass above, is burnt; consequently, no smoke escapes."

Mr. John Leighton exhibited "a Reserve Stove, to prevent Smoke Formation:" a narrow recess or chamber is placed on the back or sides, which, being covered in, except where in communication with the fire, causes coal therein to be cooked or coked, and which is the material of the fire; the recess being each day filled with coal. The open-barred bottom is retained as a means of animating the fire. There is a segmental opening just above the fire, for smoke, such as may be unburnt, to escape; the ordinary smoke-passage being usually kept closed by a register-door. This is an excellent invention.

These were but a few of the Smoke-consuming Stoves exhibited. The Chimney and Ventilating Caps were numerous; as were also the other ventilating contrivances. Some of the latter are applicable to chimneys. Howorth's Patent Revolving Archimedean Screw Ventilator has lifting-vanes acting as a screw, suspended within a tube or shaft, and centred upon an imperishable substance; these are moved, "without noise" as it is said, by a description of vane, formed of curved blades, so as to have the appearance of a cage, to catch the wind; and rotating, at least when in order, with the slightest breath; so that draught upwards is the necessary result.

The variety of design in the forms of fenders and ash-pans was very great. Sometimes the fenders had a polished bottom plate on the hearth; sometimes a fender proper was omitted, and a steel hearth-plate projecting in the form of a semicircle, merely bordered by mouldings above the raised part; or the ashes fall between polished strips or gills, or between radiating bars. In other features of fire-places, as the porcelain slabs combined with Mr. Hoole's grates, the influence of the schools was discoverable. In a fender shown by one exhibitor, the flat portion of the bottom was formed of coloured tiles. The ornamental enamelling on iron, employed in chimney-pieces as well as grates, by H. Crichley and Co., of Birmingham, is a decorative process which is capable of large application, combining beauty with durability. The iron chimney-pieces and grate-fronts of Messrs. Redmayne and Co., deserved attention, but not for their decorative features. One of the chimney-pieces, labelled "This mantel and sham complete is shown as a specimen of casting," certainly justifies one portion of the title as casting.

Waller's patent grate, exhibited by Morton and Son, of Sheffield, has the fire-clay cheeks fixed on axle-pivots, so that the front of the fire may be increased or diminished; and it has also an arrangement of orifices or tubes in a corbelled portion of the back above the fire, which is believed to help the consumption of smoke.

Among contrivances which aim at economy of fuel, Feetham and Co., and Mr. Pierce, had valved openings in the spandrels of their grates which indicate a provision for heating by conduction. Mr. Pierce's series of well-devised and cheap fire-lump grates for bed-rooms and cottages, also were shewn.

Open-fire stoves were exhibited by several manufacturers. Feetham and Co. exhibited one which would be suitable for the centre of a large public room. It has two fire-places back to back, with descending flues, open-work sides for escape of heat, and a marble slab top. Mr. Pierce's open-fire pyro-pneumatic stove is still one of the best arrangements of the terra-cotta or fire-clay material with metallic ornamental outer-casing; air, supplied from outside the building, being warmed in passing through tubes or channels which are formed in the clay.

The heating-apparatus called "gill-stove" was shown under various modified forms. Plates, or gills, closely set edgewise on the outer surface of a small fire-box, form partially-enclosed chambers in which the air is heated, and from which it is disseminated. The gills are applied both to open fire-stoves and to close stoves; and they are either apparent, like the quills of the porcupine, or there is an outer ornamental casing. The London Warming and Ventilating Company exhibited "the Gurney stove," used in the Houses of Parliament, the Department of Science and Art, and several cathedrals, including St. Paul's; the gills radiate from a central cylindrical fire-box, and the whole is placed in a shallow pan containing water, the moisture from which rises between the gills, so that the iron surface gives off not merely heat, but the requisite quantity of vapour; and the air is not "burnt" or over-dried. In the "ventilating fresh-air grate" to be set in an ordinary chimney-opening, and leaving space around the grate or at its sides, there are similar projections or gills; and air being admitted to the grate-chamber or space, from outside the building, becomes warmed, and escapes into the room by openings around the grate or in the usual manner.

The knowledge derived from the Exhibition of Heating Apparatus in use in foreign countries was small. The chimney-pieces exhibited in the Belgian Division, grates of English form, wherein radiation is the principle, indicating that they are getting into use in Belgium. Iron stoves, similar in outward form to Arnott's, are largely manufactured and used. In the Swedish Department, there were five or six specimens of the Porcelain Stove of Northern Europe, but merely the outer casing. Each consists of two portions—namely, a base or pedestal to contain the fire, which may be of wood or other fuel, and an upper case, reaching to about 7 feet from the floor, in which the flues are made to pass up and down. Thus, the whole casing may be heated, and will communicate heat to the air of the room.

Stoves were to be found in the Swiss Division; but the more important of them belonged to heating apparatus adapted to large buildings or conservatories.

CAST STEEL.

An erroneous impression—that Sheffield had been beaten by her continental rivals, during the last eleven years—appears to have obtained credence from the great success of M. Krupp's productions in Cast-steel. The ex-Master-Cutler of Sheffield, however, assures us that "Sheffield has maintained the supremacy for her manufactures which she has so long held;" and the jurors at the recent International Exhibition awarded to Sheffield a greater proportion of medals for hardware than to any of her rivals. The ex-Master adds :—

"That Sheffield has not made a more brilliant display in the Exhibition is not the fault of her manufacturers, but the consequence of the smallness of the space placed at their disposal and the serious annoyances attendant upon exhibiting—causes which have unfortunately deterred many of our first-class firms from entering an appearance at Kensington. Therefore, only a small number of our first-class manufacturers are represented at all in the Exhibition: and my surprise is that, under the circumstances, Sheffield should have made so creditable a display.

"That many of our continental rivals should have comparatively made 'greater progress' during the last 11 years than we, is but the natural consequence of our having to start from an advanced position, beyond which progress is necessarily slow and laborious, while they need only to copy our patterns and take advantage of our experience, and the liberality (but questionable policy) of our manufacturers, who have at all times freely given them access to their factories, to make a large stride a-head of the very early stage of advancement they had attained in 1851."—*Letter to the Times, Sept. 12, 1862.*

But the fallacy of the case attempted to be made out against Sheffield is shown by its reliance upon the manufacture of large castings of steel, by M. Krupp, and which is not a branch wherein Sheffield ever claimed any supremacy; on the contrary, the ex-Master says :—

"It is a branch of manufacture M. Krupp was the first to develop, and which was practically unknown in Sheffield until a few years ago. M. Krupp had made great advances before Sheffield started in the race, but, though the manufacture of large castings of steel was so recently introduced into Sheffield, we are generally admitted to have entered upon it with such success that the only superiority M. Krupp himself retains is in the magnitude of his castings; and mere size is so simple a matter of development, that whenever a demand for large castings arises sufficient to justify the requisite outlay in machinery, Sheffield will no doubt produce them of any size that may be required. In this branch the progress has been far more 'rapid' at Sheffield than on the Continent.

"The fact that M. Krupp was the first to develop a new branch of hardware manufacture is no proof that Sheffield has lost her supremacy in the older branches of manufacture, for excellence in which she has so long been famous.

"In conclusion, I fearlessly assert that no country equals Sheffield for the quality of its steel, tools, cutlery, and the productions of its other staple trades; that Sheffield makes as good castings of steel as any of the Prussian manufacturers, and, moreover, that whenever a demand arises to justify the outlay in machinery, Sheffield will produce steel castings as monstrous as may be required."

The fairly-earned manufacturing reputation of Sheffield must be considered as fully vindicated by the above communication.

Natural Philosophy.

THE ROYAL SOCIETY.

At the Anniversary Meeting of the Royal Society, having rendered due honour to the memory of the late Sir Benjamin Brodie, his predecessor in the chair, General Sabine, instead of reviewing the papers read during the past session, communicated to the meeting particulars of certain important proceedings in which the Council had been engaged. For example, a few years ago a Committee of the Royal Society was appointed to consider as to the best way in which a large reflecting telescope could be established in some part of the Southern Hemisphere for the purpose of astronomical observation, and more especially of the nebulæ. The report of this Committee was published, and the project seemed likely to be realized with the sanction of Government, when the breaking out of the war with Russia occasioned its being laid aside. Nothing further was done in the matter until about three months since, when a communication was received from the Secretary of State for the Colonies, requesting the opinion of the Royal Society on the question, as above stated, for transmission to Sir Henry Barkly, Governor of the Colony of Victoria. There is a Royal Society as well as an Astronomical Observatory in Melbourne, and it appears that some of the leading members, comprising the Board of Visitors, have taken steps towards the establishment of a large reflecting telescope in the neighbourhood of their growing capital. But before applying to the Colonial Government for a pecuniary grant, they, to quote their own words, seek "an expression of opinion from scientific men in England as to the importance of the results to be expected; the most suitable construction of telescope for the purpose, both as to the optical part and the mounting; its probable cost, and the time requisite for its completion."

The answer which, as General Sabine informed the meeting, will be sent to these inquiries, will now be much more complete and satisfactory than it could have been when the question was first raised; for in addition to the experience gained by the Earl of Rosse and by Mr. Lassell, who with a four-feet reflector constructed at his own cost, and under his own superintendence, has been observing for the past twelvemonth at Malta, there has been an advance of essential importance in optical science. Hence, as General Sabine remarked, however great may have been the former disappointment, "there will be, if present hopes are realized, no reason to regret that it has been left to the Colony of Victoria to carry into execution an undertaking which may well be expected to hold a high place in the annals of science in all future time; and thus to set a noble example to the other colonies of the British Crown."

Another subject noticed in the address was the voluminous

manuscript Catalogue,—or Index as it may be called,—which has been in course of compilation for the last four years, under supervision of a Committee of the Royal Society. This catalogue is to include the titles of papers and reports published in "The Transactions and Proceedings of Scientific Societies" and in scientific periodicals from all parts of the civilized world. Among them are the Academies of Russia, Sweden, Denmark, of the Netherlands, Germany, and Switzerland, of France, Spain, and Italy, and of the States of North America. Some notion of the magnitude of the work may be formed from the fact that it begins with the year 1800, and is brought down to the close of 1860. The titles are all copied in quadruplicate; and considerable progress has been made towards rendering them available for reference, as sixty-two volumes, forming a serial index, are now bound and placed in the Society's library. General Sabine led the meeting to expect that the task would be completed within the coming year.

The grounds of the award of the four medals were set forth by General Sabine, and each case was shown as resting on its own especial merits.—*Abridged from the Athenæum.*

THE DECIMAL SYSTEM OF WEIGHTS AND MEASURES.

The Report of the Select Committee appointed to consider the practicability of adopting a simple and uniform system of weights and measures has been published. The following recommendations have been laid before Parliament, together with a great mass of evidence and tabular appendices:—

"1. That the use of the metric system be rendered legal. No compulsory measures should be resorted to until they are sanctioned by the general conviction of the public.

"2. That a Department of Weights and Measures be established in connexion with the Board of Trade. It would thus become subordinate to the Government, and responsible to Parliament. To it should be entrusted the conservation and verification of the standards, the superintendence of inspectors, and the general duties incident to such a department. It should also take such measures as may from time to time promote the use and extend the knowledge of the metric system in the departments of Government and among the people.

"3. The Government should sanction the use of the metric system (together with our present one) in the levying of the Customs' duties; thus familiarizing it among our merchants and manufacturers, and giving facilities to foreign traders in their dealings with this country. Its use, combined with that of our own system, in Government contracts, has also been suggested.

"4. The metric system should form one of the subjects of examination in the competitive examinations of the Civil Service.

"5. The *gramme* should be used as a weight for foreign letters and books at the Post Office.

"6. The Committee of Council on Education should require the metric system to be taught (as might easily be done by means of tables and diagrams) in all schools receiving grants of public money.

"7. In the public statistics of the country quantities should be expressed in terms of the metric system in juxtaposition with those of our own, as suggested by the International Statistical Congress.

"8. In private bills before Parliament the use of the metric system should be allowed.

"9. The only weights and measures in use should be the metric and imperial, until the metric has been generally adopted.

"10. The proviso in the 5th and 6th William IV., cap. 63, clause 6, allowing the use of 'local and customary measures' in cases where the vessel employed 'is not represented as containing any amount of imperial measure or of any fixed local or customary measure heretofore in use,' should be repealed as giving facilities to evade the statute.

"11. The department which it is proposed to appoint should make an annual report to Parliament."

ACADEMY OF SCIENCES, PARIS.

THE following are the prize-questions proposed by this body at its last great annual meeting:—1. Mathematics.—To discuss with care the observations of tides made in the principal ports of France, and compare them to the theory (3000f., papers to be sent in before the 1st of June, 1865); to re-examine the phenomena of capillarity, and compare them to the results of calculation (3000f., 1st of April, 1864); to improve the geometrical theory of polyhedrons (3000f., 1st of January, 1864); to establish a complete and rigorous theory concerning the equilibrium of floating bodies (3000f., 1st of July, 1864). 2. Mechanics.—To introduce some important improvement in the application of steam to the Imperial navy (6000f., 1st of November, 1863). 3. Bordin Prizes.—On some question of optics, at the candidate's choice (3000f., 1st of July, 1864). To determine the direction and relative intensities of electric currents produced by various thermo-electrical substances (3000f., 1st of July, 1864). To effect some improvement in the mechanical theory of heat (3000f., 1st of July, 1864). 4. Natural Philosophy.—On the comparative anatomy of the nervous system of fish (3000f., 1st of September, 1864). To study the changes effected during germination in the constitution of the tissues of the embryo and perisperm (3300f., 1st of April, 1864). On the production of hybrid animals by means of artificial fecundation (3300f., 1st of September, 1863). 5. Medicine.—To trace the history of Pellagra (5000f., 1st of April, 1864). 6. Medicine and Surgery.—On the application of electricity to therapeutics (5000f., 1st of April, 1866). 7. Surgery.—On the preservation of members by preserving the periosteum (the Academy offers 10,000f.; the Emperor also 10,000f., 1st of April, 1866). 8. Bordin prizes of 3000f. each, to be sent in before the 31st of December, 1863:—On the distribution of the vessels of the latex in the organs of plants; on the anatomical history of coral and other zoophytes of the same family; on the structure of the stems of plants, with a view to determine their respective families.

FORM AND MOTION OF WAVES.

PROFESSOR W. J. M. RANKINE has read to the British Association a paper "On the Form and Motion of Waves at and near the Surface of Deep Waters." This paper was a summary of the nature and results of a mathematical investigation, the details of which

have been communicated to the Royal Society. The investigations of the Astronomer Royal and of Mr. Stokes on the question of straight-crested parallel waves in a liquid, are based on the supposition that the displacements of the particles are small compared with the length of a wave. They proceed by a method of approximation, which Mr. Stokes has carried furthest. Hence it has been very generally inferred that the results of those investigations when applied to waves in which the displacements are considerable, as compared with the length of wave, are only approximate. In the present paper, the author proves that one of those results,—viz., in very deep water the particles move with an uniform angular velocity in vertical circles, where radii diminish in geometrical progression with increased depth, and consequently, that surfaces of equal pressure, including the upper surface, are trochoidal,—is exact for all possible displacements, how great soever. The author proves further, that the centres of the orbits of the particles in a given surface of equal pressure stand at a higher level than the same particles do when the liquid is still, by a height which is equal to the height due to the velocity of revolution of the particles; and that, consequently, the mechanical energy of a wave is half actual and half potential (half being due to motion and half to elevation), and the destructive power of a wave is double of that due to the motion of its particles alone. The hydrostatic pressure at each individual particle during the wave-motion is the same as if the liquid were still. In an Appendix to the paper is given the investigation of the problem, to find approximately the amount of the pressure required to overcome the friction between a trochoidal wave-surface and a wave-shaped solid in contact with it. The application of the result of this investigation to the resistance of ships was explained in a paper read to the British Association in 1861, and published in various engineering journals in October of that year.—*Athenæum Report.*

CONFORMATION OF THE ALPS.

PROFESSOR TYNDALL, in his very able paper, in the *Philosophical Magazine*, No. 161, arrives at the following conclusions, after having, during the last seven summers, viewed the Alps from many commanding points:—

It is, then, perfectly certain that all this mountain region was held by ice, enormous as to mass and in incessant motion. That such an agent was competent to plough out the Alpine valleys cannot, I think, be doubted; while the fact that during the ages which must have elapsed since its disappearance the ordinary denuding action of the atmosphere has been unable, in most cases, to obliterate even the superficial traces of the glaciers, suggests the incompetence of that action to produce the same effect. That the glaciers have been the real excavators, seems to me far more probable than the supposition that they merely filled valleys which had been previously formed by water denudation. Indeed the

choice lies between these two suppositions : shall we assume that the glaciers filled valleys which were previously formed by what would undoubtedly be a weaker agent? or shall we conclude that they have been the excavators which have furrowed the uplifted land with the valleys which now intersect it? I do not hesitate to accept the latter view ; and this view will carry us still further. According to it the glacier is essentially self-destructive. The more deeply it ploughs the surface of the earth, the more must it retreat. Let the present Alpine valleys be filled to the level of the adjacent ridges, and vast glaciers would again start into existence; but every one of these valleys is a kind of furnace which sends draughts of hot air up to the heights, and thus effectually prevents the formation of ice. While standing on the summit of the Grauhaupt a week or two ago, I was perfectly astonished at the force with which these gusts of heated air rose vertically from the Val du Lys. Marked by the precipitated vapours which chanced to be afloat at the time, the vertical gusts were often as violent as the draught from a factory chimney. Thus, given the uplifted land, and we have a glacial epoch ; let the ice work down the earth, every foot it sinks necessitates its own diminution ; the glaciers shrink as the valleys deepen ; and finally we have a state of things in which the ice has dwindled to limits which barely serve as a key to the stupendous operations of a bygone geologic age. To account for a glacial epoch, then, we need not resort to the hard hypothesis of a change in the amount of solar emission, or of a change in the temperature of space traversed by our system. Elevations of the land, which would naturally accompany the gradual cooling of the earth, are quite competent to account for such an epoch ; and the ice itself, in the absence of any other agency, would be competent to destroy the conditions which gave it birth.

CONNEXION BETWEEN EARTHQUAKES AND MAGNETIC DISTURBANCES. BY DR. J. LAMONT.

On the 26th of December, 1861, at 8 o'clock in the morning, as I was recording the position of the magnetic instruments (of which there are six in the magnetic observatory—two for declination, two for intensity, and two for inclination), I observed on all the instruments an unusual disturbance, consisting in the fact that the position rapidly and irregularly increased and then decreased by several divisions, and at the same time a vibration in a vertical direction took place. The vibration of the needles only lasted a short time ; but the rapid alterations of the position continued, although diminishing in intensity, till about half-past 8. A few days afterwards, news arrived that at exactly the same time at which the above was observed, an earthquake in several parts of Greece had produced great devastation.

Here is a new proof, not only that the concussions which an earthquake produces are felt at great distances, but that the forces which produce the earthquake also modify the magnetism of the

earth in a certain degree. The modifications doubtless consist in the fact that an *earth-current is produced*, which has also been so far confirmed, in the above case, by the fact that the arrangements at this observatory for observing the earth-current exhibited unusual activity at the time mentioned.

It is very remarkable that the earthquake which occurred in Greece on the 18th of April, 1842, produced a similar action, while hitherto no action has been perceived from other earthquakes often at less distance.—Poggendorff's *Annalen*, January, 1862; *Philosophical Magazine*, No. 157.

MAGNETIC PHENOMENA IN RUSSIA.

A NOTICE has appeared in a foreign journal of certain very remarkable Magnetic Phenomena which were observed in Russia. It appears that while making a survey with pendulum experiments in the neighbourhood of Moscow, the officers employed were surprised by finding a marked inclination of the pendulum towards the city. With a view to obtain data for comparison, the observation was repeated at another station some miles distant, and afterwards at others, until an entire sweep had been made round the region, as it may be called, of the ancient capital of Muscovy. But in every instance the result was the same—an attraction, so to speak, of the pendulum towards the city as to a focus. The result is so anomalous, that mathematicians are at a loss to account for it; and it is partly in the hope of eliciting further information that we publish these particulars. We should like to know at what distance from Moscow the observations were made. Geologists might then be questioned as to the nature of the strata within the circum-perambulated area. Meanwhile this focal attraction remains a very curious subject of speculation.—*Athenæum*.

THE COSMICAL FEATURES OF TERRESTRIAL MAGNETISM

FORMED the subject of the Reade lecture, delivered in the Senate House of the University of Cambridge in May last by General Sabine, so renowned for his labours in this department of science, who has devoted very much attention to it ever since his voyage to the Arctic Regions in 1819, and who has been mainly instrumental in the establishment of observatories in different parts of the globe especially devoted to the recording of magnetic phenomena. These records have been published from time to time at the expense of the Government, under General Sabine's superintendence, and now have led to remarkable generalizations, which are set forth in his lecture (printed in the *Philosophical Magazine*), which is a valuable *resumé* of the progress of magnetical research. We have only space here to indicate the interesting topics treated of.—"The existence of periodical laws discoverable in the mean effects of the larger magnetic disturbances," (first announced in 1851); "The existence of a periodical variation in the magnetic disturbance coinciding in period and epoch with the variation in frequency and

magnitude of the solar spots," announced by M. Schwabe; "The semi-annual inequality in the diurnal variations of the declination;" and "The solar and lunar diurnal variations." All these have been closely studied, and all tend to show a remarkable cosmical connexion between the sun and moon and magnetic variations observed on the earth.

MAGNETISM OF IRON SHIPS.

MR. F. J. EVANS has read to the British Association papers by Mr. A. Smith and himself conjointly, "On the Three Reports of the Liverpool Compass Committee, and other recent Publications on the same subject,"—undertaken at the request of the British Association. The papers included were severally by the Astronomer Royal, the late Dr. Scoresby, and Capt. Johnston, R.N., on the deviation of the compass and the magnetism of iron ships; as also contributions in the same field of inquiry by the reporters. After a general review of the formulæ employed and recommended, the Report states that the first and most important general result which is derived from all the observations recorded in these works, and from many more which have not been published, is that the observed deviations of the compass are represented by the formulæ derived from Poisson's theory with a correctness which is within the limits of error of observation. After bearing testimony to the practical and scientific knowledge brought to the subject by the secretary (Mr. Rundell) of the Liverpool Compass Committee, and the amount of industry and zeal which have given to the three Reports published the highest possible value, it is considered that the results of their extended and varied observations lead to definite conclusions which may nearly, to the full extent, be accepted as being now established. Among these are—1. That the magnetism of iron ships is distributed according to precise and well-determined laws; 2. That a definite magnetic character is impressed on every iron ship while on the building slip, which is never afterwards entirely lost; 3. That a considerable reduction takes place in the magnetism of an iron ship on first changing her position after launching, but afterwards that any permanent change in its direction or amount is a slow and gradual process; 4. That the original magnetism of an iron ship is constantly subject to small fluctuations from change of position, arising from new magnetic inductions; 5. That the compass errors occasioned by the more permanent part of a ship's magnetism may be successfully compensated; and that this compensation equalizes the directive power of the compass-needle on the several courses on which a ship may be placed. On the effect of heeling, a considerable body of evidence is collected: the most important practical result, as to the amount of the heeling error, is the great amount to which it reaches in certain ships and in certain positions in the ship, several examples of even two degrees of change for one degree of heel being recorded. The Report points to certain

desiderata :—1. That in the construction of iron vessels, regard should be had to the providing a proper place for the compass ; the present difficulty being to reconcile this with the requirements of construction and of working the vessel. 2. That for throwing light on the points which are still obscure, the complete magnetic history of some iron vessels in various latitudes should be known : this might be accomplished by observations of durations, and horizontal and vertical force, made at various fixed positions, in some new iron vessel, in an extended voyage in both hemispheres.

The Astronomer Royal wished to say that as regarded the two ships alluded to in the Report whose magnetism it had been stated he had investigated, at that time absolutely nothing was known of the distinction so necessary to be attended to between permanent magnetism and the magnetism induced both by the change of position of the ship and the action of the sea upon her ; and the plates furnished to him for examination were found to be so various in the permanent magnetism they had acquired from the various processes, as rolling, cutting, punching, &c., through which they had passed, that he had been led to suppose that this must, in the ship, mark every other cause of magnetic change.

ATMOSPHERIC REFRACTION.

PROFESSOR CHALLIS has communicated to the British Association a paper, on the effect of the Atmospheric Refractions of the sun, moon, and planets, in which reasons were given, from the results of calculations, for inferring that the moon has an atmosphere of very small extent, the effect of which is perceptible in the occultation of a star, because, by reason of the refraction of the atmosphere, the star would disappear, and re-appear when the line of vision was within the moon's apparent boundary. The same result would be obtained from a solar eclipse. The apparent diameters of the planets will, for like reasons, be augmented by the effect of refraction; and on account of the great distance of these bodies from the earth, the eclipse of a satellite will take place as soon as the visual ray is bent by the interposition of the atmosphere.

THE ATMOSPHERE IN RELATION TO ASTRONOMY.

M. RADAU, having been called to account for saying in the *Cosmos* that a very dry Atmosphere is *not* favourable to Astronomical Observations, supports his statement by quotations from eminent authorities. Arago says, "When the atmosphere is very dry, telescopes work badly ; but when it is charged with moisture the images of the stars have a remarkable neatness." Father Secchi, of Rome, says that the best evenings are those with a "discreta umidità." M. D'Abbadie, in his "Géodesie d'Ethiopie," says of a certain evening, "Atmosphere admirably moist, which is rare in Ethiopia, and very favourable to delicate observations." —*Illustrated London News.*

THE EARTH'S ATMOSPHERE.

PROFESSOR CHALLIS has read to the British Association a paper to show that the Earth's Atmosphere is of limited extent, and reasons were adduced, in the absence of data for calculating the exact height, for concluding that it does not extend to the moon. It was argued on the hypothesis of the atomic constitution of bodies, that the upward resultant of the molecular forces on any atom, since it decreases as the height increases, must eventually become just equal to the force of gravity, and that beyond the height at which this equality is satisfied, there can be no more atoms, the atmosphere terminating with a small finite density. It has been generally supposed that the earth's atmosphere is about 70 miles high, but on no definite grounds, and the estimates of the height have been very various. Against the opinion that it extends as far as the moon, it was argued, that, as the moon would in that case attach to itself a considerable portion by its gravitation, which would necessarily have some connexion with the rest, there would be a continual *drag* on the portion more immediately surrounding the earth, and intermediately on the earth itself, which would in some degree retard the rotation on its axis. Hence, if, as there is reason to suppose, the rotation be strictly uniform, the earth's atmosphere cannot extend to the moon. The author also stated that if by balloon ascents the barometer and thermometer were observed at two heights ascertained by observation, one considerably above the other, and both above the region in which the currents from the equator influence the temperature, data would be furnished by which an approximate determination of the height of the atmosphere might be attempted.

PRESSURE OF THE ATMOSPHERE.

M. KREIL, the eminent Austrian meteorologist, has laid before the Academy of Sciences at Vienna the results of his researches on the changes of the Atmospheric Pressure during long periods, based on data obtained from meteorological observations regularly kept at Milan for more than ninety years, at Vienna during eighty-seven years, at Prague since 1800, and at the Abbey of Kremsmünster for forty years. Besides the daily and annual variations, the atmospheric pressure undergoes others at long periods, of which one coincides with the proximity of the summer solstice. During the first twenty years of the cycle of observations, commencing in 1770, the pressure was more intense in July than June. The contrary was the case in the three following years. From 1820 to 1850 the maximum fell in July, but since 1851 the mean of pressure has been the same in June and July. The mean of January undergoes the same amount of ascending regular variations, alternating in periods from ten years to twenty years, during a period of ninety years. The variations of July follow then a period of sixty years, those of January a period of twenty years—as deter-

mined by the examinations of the above-named observations. During the first thirty years of the present century the atmospheric pressure has remained nearly constant; it has diminished during the following twenty years, and has become constant during the last ten years. M. Kreil thinks that in the present state of our knowledge attempts to explain these phenomena would be premature.—*Illustrated London News.*

ATMOSPHERICAL TEMPERATURE.

Dr. Balfour Baikie, in some Observations made on the West Side of Tropical Africa, says:—

"According to observations which I have made pretty regularly since 1857 in Mipe, and at the confluence of the Kwora and Binuwè, the coldest period during the twenty-four hours is from fifteen minutes to an hour after sunrise.

"With a very few exceptions, the thermometer always falls just after sunrise, from 0°·2 to 2°. If the thermometer be read about fifteen or twenty minutes before sunrise, and then at sunrise, it will be found to have risen from 0°·5 to 1°, but fifteen or twenty minutes later it will be found to have fallen again. For example, this morning at 5h. 45m. A.M. the thermometer was 75°; at sunrise it was 76°, and at 6h. 30m. it was again 75°.

"Another constant rule is, that the lower the thermometer the more certain is this fall after sunrise, and the greater its extent. In December and January the mornings are very cold, the thermometer sometimes showing 60°, and even 58°, and it is then that the fall after sunrise is most marked. During the rain-season the temperature is more equable, less in extremes, and then this fall is much less, sometimes scarcely perceptible. As far as I have observed, the fall is greater after sunrise the farther north we go, and is more marked on high than on low lands. In December and January I have seen the thermometer range more than 40° daily. From June to October the range seldom exceeds 15° or 16° daily.

"During 1860 and 1861, the temperature of Tornado rain, whether by night or by day, was rarely below 70° or above 72°. Tornadoes are from N.E. to S.E. Rain coming from the S.W. is generally rather warmer.—*Edinb. New Philos. Journal,* No. 32.

NOCTURNAL RADIATION.

Professor Marcet has communicated to the *Philosophical Magazine,* No. 151, certain "Experiments on the Comparative Effects of Nocturnal Radiation from the Surface of the Ground over a large Sheet of Water," whence he considers the following conclusions may be safely drawn:—

1. The gradual increase of temperature occurring on ascending through the lower strata of the atmosphere, which appears constantly to prevail on land about and after sunset, is not apparent above a large surface of water.

2. The immediate vicinity of a large sheet of water is sufficient to modify to a considerable extent the effects of the nocturnal radiation of the earth, and thereby materially diminish the increase of temperature observed under ordinary circumstances on ascending above the surface of the ground.

3. One cannot help being struck by the great difference (amounting to between 2 and 3 Centigrade degrees) constantly observed between the temperature of the atmosphere a few feet above the ground, and that of the air at the same height above a large sheet of water.

DISTRIBUTION OF FOG.

A PAPER has been read to the British Association, "On the Distribution of Fog round the Coasts of the British Islands," by Dr. Gladstone. Certain conclusions on this subject, formerly arrived at by the author, had been re-examined by means of additional returns from the meteorological journals kept at all the stations belonging to the three general lighthouse authorities in England, Scotland, and Ireland, and some returns lent him from the Royal Observatory. These afforded confirmation of the greater uniformity of distribution of fogs over the surface of the sea than on land, of their great prevalency where the south-west wind from the ocean strikes upon high ground, of the comparative infrequency of fog on the coasts of straits or portions of sea nearly surrounded by land, and other points previously noted. The returns also indicated that some years are much more foggy than others in nearly all localities; that the same fog sometimes prevails over a large extent of country; and that the frequency of fog differs very greatly in different months of the year, January, February, or March being on some coasts almost free. A generally-accepted means of distinguishing between "fog" and "mist" is a great desideratum.

PROPAGATION OF SOUND IN THE AIR.

NEWTON was the first to study the Propagation of Motion in the Atmosphere, and the solution which he gave still excites the admiration of geometers, and is termed by Laplace "a monument of his genius." Sometimes, however, it does not entirely agree with experience; for instance, it gives for the swiftness of propagation a value of about a sixth below that given by observation. Since his time Lagrange, Euler, Laplace, Poisson, and other geometers, have occupied themselves with this problem with the view of either establishing the true mathematical theory, or discovering the cause of the difference between calculation and experience. The subject has also been taken up by the eminent mathematician Duhamel, who has laid a memoir before his associates of the French Academy, giving his calculations, whereby he arrives at this singular consequence—"that the theoretic swift-

ness of sound in the air, supposing that there is no elevation of temperature, is identical with that given by experience." The hypothesis of an elevation of temperature, which appears so probable, and which comes so conveniently to the assistance of the theory, becomes a difficulty, and we find ourselves compelled either to demonstrate that this hypothesis is not legitimate, or to find a new and hitherto unknown cause which shall neutralize the effect. The memoir, which appears in No 1 of the new volume of the *Comptes Rendus*, has excited some little discussion among mathematicians, and comments by M. Clausius and others have appeared. M. Duhamel, however, maintains his position. —*Illustrated London News.*

REGELATION OF SNOW-GRANULES.

PROFESSOR TYNDALL writes to the *Philosophical Magazine*, No. 154:—"I this morning (March 21) noticed an extremely interesting case of Regelation. A layer of snow between 1 and 2 inches in thickness had fallen on the glass roof of a small greenhouse, into which a door opened from the mansion to which the greenhouse was attached. Air slightly warmed, acting on the glass surface from underneath, melted the snow in immediate contact with the glass, and the layer in consequence slid slowly down the glass roof. The inclination of the roof was very gentle, and the motion correspondingly gradual. When the layer overshot the edge of the roof it did not drop off, but bent like a flexible body, and hung down over the edge for several inches. The continuity of the layer was broken into rectangular spaces by the inclined longitudinal sashes of the roof, and from local circumstances one side of the roof was warmed a little more than the other; hence the subdivisions of the layer moved with different velocities, and overhung the edge to different depths. The bent and down-hanging layer of snow in some cases actually curled up inwards.

"Faraday has shown that when small fragments of ice float on water, if two of them touch each other, they instantly cement themselves at the point of contact; and on causing a row of fragments to touch, by laying hold of the terminal piece of the row you can draw all the others after it. A similar cementing must have taken place among the particles of snow now in question, which were immersed in the water of liquefaction near the surface of the glass. But Faraday has also shown that, when two fragments of ice are thus united, a hinge-like motion sets in when you try to separate the one from the other by a lateral push: one fragment might in fact be caused to roll round another, like a wheel, by incipient rupture, and the re-establishment of regelation. The power of motion thus experimentally demonstrated rendered it an easy possibility for the snow in question to bend itself in the manner observed. The lowermost granules, subjected to pressure when the support of the roof had been withdrawn, rolled over each other without a destruction of continuity, and thus enabled the snow layer to bend as if it were viscous. The curling

up was evidently due to a contraction of the inner surface of the layer, produced, no doubt, by the accommodation of the granules to each other as they slowly diminished in size."

FREEZING OF SALINE SOLUTIONS.

DR. RÜDORFF has shown that pure ice is formed by the Freezing of Saline Solutions, and that some salts affect the freezing-point of the water in which they are dissolved as anhydrous salts, others as salts containing water. M. Dufour tried to prove, in a paper which appeared simultaneously, that the ice which separates from a saline solution contains salt which separates in the solid form at the same time as the ice. The well-known fact, that the proportion of salt contained in ice so formed is always smaller than that contained in the original saline solution, and that it is smaller the slower has been the formation of the ice, is explained by M. Dufour by supposing that the remaining solution re-dissolves the salt which separates out with the ice. Experiments afford an additional proof that the salt contained in ice produced in this way is due to a portion of the solution adhering to it or being enclosed by it.—*Philosophical Magazine*, No. 157.

PROPERTIES OF AIR AND WATER.

PROFESSOR FRANKLAND, in a lecture delivered by him at the Royal Institution, first treated of the extent and distribution of the Atmosphere as shown by a diagram, on which were represented the highest mountains of the globe and the greatest height attained by aeronauts—viz., about $5\frac{3}{4}$ miles, by Mr. Glaisher, in his late scientific balloon ascent. Prof. Frankland next proved that air has weight, and ascertained that air in a certain hollow sphere weighed about 200 grains, and stated that the weight of the air in the lecture-room was above a ton. The pressure and *vis inertiæ* of the atmosphere were shown by a number of interesting and convincing experiments by the aid of the air-pump, exhausting syringe, &c. The principle on which barometers are constructed, and their important use in informing us of the varying pressure of the atmosphere, were duly considered. A small steam-engine was put in motion by the force exerted by compressed air when the pressure was removed; and, by means of a model tube, the method by which the Pneumatic Dispatch Company propose to convey parcels was shown. The blue colour of the atmosphere the Professor attributed to its absorption of the other rays of the spectrum. To illustrate this, the electric lamp was employed to produce a beautiful spectrum, and exhibit, among other phenomena, the complementary colours, mountain peaks illumined by the setting sun, the lurid sun in a dense fog, &c.—*Illustrated London News.*

DEW-BOW SEEN ON THE SURFACE OF MUD.

PROFESSOR MACQUORN RANKINE, in the *Philosophical Magazine*, No. 153, relates:—

"There was seen to-day (February 13, 1862) by myself and some other persons in this neighbourhood, a very beautiful phenomenon, of which the cause is obvious, and of such a nature that one would expect the phenomenon to occur frequently; but I do not remember to have yet seen any instance of it recorded in any scientific publication. I refer to a prismatically-coloured hyperbolic iris, or bow of the first order, exactly resembling that sometimes seen on a field of dewy grass; but in this case it was displayed on the muddy surface of a by-road near Glasgow, and on the less trodden parts of an adjoining turnpike-road, throughout a distance of more than a mile. The time was between 12 h. 30 m. and 1 h. P.M. Greenwich mean time; the morning had been hazy, but the mist had cleared away, and the sun was shining brightly.

"The angular dimensions of the iris were obviously the same with those of a rainbow of the first order; its colours were complete from red to violet, and very bright and distinct, especially where the mud was softest and moistest; where a sheet of water, how thin soever, covered the mud, the iris vanished. No trace of an iris could be seen on the grass, in the sky, or anywhere but on the mud; and on those parts of the turnpike-road where the mud had been much disturbed no iris was visible.

"The necessary conclusion from this appearance is, that the surface of the mud must have been thickly covered with globules of pure water, perfectly spherical, and not in absolute contact with the mud, although resting on it; but those globules must have been extremely minute, for they were invisible to the closest inspection with the naked eye."

THE RAINBOW.

THERE has been read to the British Association, a paper "On the Supernumerary Bows in the Rainbow," by the Rev. J. Dingle. The author said he had investigated a method of approximating to the size of the drops of rain corresponding to any given position of the supernumerary bows produced by the interference of the two luminiferous surfaces proceeding from each drop. It appeared from his tables appended to the paper that the size which Dr. Young (without giving his method of calculation) had assigned to the drops under certain conditions was within $\frac{1}{2000}$th of an inch of the truth, and was more accurate than that assigned subsequently by Mr. Potter, whose method was not quite satisfactory. The subject was interesting as illustrating the marvellous accuracy with which the operations of nature are carried out, and the delicate adaptation of our organs for discerning them.

ARTIFICIAL RAINDROPS.

M. MARCEL DE SERRES has sent to the French Academy of Sciences a specimen of clay on which he had produced, by means of an Artificial Rain, impressions similar to those of the ancient world figured and described by Sir C. Lyell and other geologists. The modern impressions differ from the ancient in being only concave circles and not having any convex impressions. He hopes to produce the latter by varying the experiments.

NEW BAROMETER.

MR. GLAISHER has exhibited to the British Association a new Mercurial Barometer which had been designed and constructed by Messrs. Negretti and Zambra, for the purpose of checking the readings of the Gay-Lussac's barometer, which had been used in Mr. Glaisher's several late balloon ascents. The correctness of the readings of a Gay-Lussac's barometer at low pressure depended upon the evenness of the tube, and it is difficult to colligate so large a tube. Messrs. Negretti and Zambra selected a good tube, six feet in length, attaching a cistern to its lower end. Mercury was boiled throughout the length of the tube; at the entrance of the cistern was placed a stopcock, by which means any definite quantity of mercury could be allowed to pass from the upper half of the tube into the cistern, and its height in the cistern noted and engraved; then a second portion, and so on. This process could be repeated. When the cistern was thus satisfactorily divided, the tube was cut in two, and to the upper half the cistern was joined; a scale was attached to this portion, and the reverse operation was performed,—viz., allowing portions of the mercury to pass from the cistern into the tube, which could be regulated by means of the stopcock, and thus the scale was divided. The process, in fact, is using the tube to graduate itself. In carriage, the stopcock locks the mercury in the tube. This instrument was used, and acted well on the extreme high ascent.

ANEROID BAROMETER.

THERE has been read to the British Association a paper "On the Performance, under trying circumstances, of a very small Aneroid Barometer," by Mr. G. J. Symons. This instrument, which the author exhibited, had been worn constantly by him recently while at sea in rough weather, while riding and driving over roadless districts in the Orkneys, and also on several occasions when rough climbing and severe jumps had been necessary; he therefore presumed he might reasonably conclude that it had been fully tried. It had been tested before, during, and after the voyage, and had in each case given the same result when compared with mercurial standards. Mr. Symons, therefore, considers that much credit is due to the makers (Negretti and Zambra) for producing so strongly-made and accurate an instrument of the very small size of two inches diameter and three-quarters of an inch thick.

COMPRESSSD GAS FOR BAROMETRIC PURPOSES.

DR. I. ASHE has read to the British Association a paper suggesting the use of Compressed Gas applied on a new principle to the elevation of a column of liquid for Barometric Purposes. He proposed to produce an invariable amount of compression of gas for this purpose by means of an invariable weight compressing in a vacuum a miniature gas reservoir carefully made air-tight by gilding.

The pressure of the air and that of the column of liquid would then vary inversely, and by employing water or oil in the tube the same amount of variation in the height of the column might be obtained by this contrivance in a tube 42 inches long, as it is at present obtained with the water barometer having a tube of 34 feet in length. Dr. Ashe also proposed the employment of a bulb, with a very minute aperture at the top of the barometer tube by which to permit the necessary access of air to the top of the column of liquid ; the advantage of this contrivance would be the prevention of constant and but momentary variations in the height of the column of liquid, owing to the passage of momentary ascensive gusts, which would otherwise cause such constant oscillations as to render so sensitive an instrument valueless.

CYCLONE THEÓRY OF STORMS.

Mr. S. A. Rowell, in a paper read to the British Association, objects to this theory, as follows:—Admitting that the winds in storms do at times take a more or less circular course, and that whirlwinds may sometimes occur during storms, I believe that these are only occasional and minor phenomena in storms, and not the storm itself, as represented in the Cyclone Theory. I object to the Cyclone theory on the grounds, that it is opposed to all the known natural laws which affect the condition of the atmosphere, as I believe it is impossible that a disc of some hundreds of miles in diameter, but of a mere mile or so in thickness, of air lighter than the general atmosphere, could make its way for days and days in succession through the densest part of the atmosphere,—that the evidence in support of the theory is insufficient (this I shall attempt to show by the aid of diagrams from Reid's *Law of Storms*, and a general reference to works of the kind),—and that the phenomena of the (so-called) Cyclone storms may be otherwise accounted for.

DISINTEGRATION OF STONES.

Professor J. Thomson has read to the British Association a paper "On the Disintegration of Stones exposed in Buildings and otherwise to Atmospheric Influence." Prof. Thomson having first guarded against being understood as meaning to assign any one single cause for the disintegration of stones in general, gave reasons to show—1st. That there may frequently be observed cases of disintegration which are not referable to a softening or weakening of the stone by the dissolving away or the chemical alteration of portions of itself, but in which the crumbling is to be attributed to a disruptive force possessed by crystalline matter in solidifying itself in pores or cavities from liquid permeating the stone. 2nd. That in the cases in question the crumbling away of the stones, when not such as is caused by the freezing of water in pores, usually occurs in the greatest degree at places to which, by the

those elevations by comparison with those found directly by Daniell's and Regnault's Hygrometers, and also to compare the results as found by the two hygrometers together; to collect air at different elevations; to note the height and kind of clouds, their density and thickness at different elevations; to determine the rate and direction of different currents in the atmosphere, if possible; to make observation on sound; to note atmospherical phenomena in general, and to make general observations. The instruments used consisted of mercurial and aneroid barometers; dry and wet bulb thermometers, also an exceedingly sensitive thermometer; Daniell's Dew-point Hygrometer; Regnault's Condensing Hygrometer; solar radiation thermometer; maximum and minimum thermometers; a small magnet for horizontal vibrations hermetically sealed, and exhausted glass-tubes; ozone test-papers, &c. All the instruments were constructed by Messrs. Negretti and Zambra, excepting the mercurial barometer, which was entrusted to Mr. P. Adre, of London.

He then detailed the instruments, the observing arrangements and the circumstances of the ascents, of which three were made from Wolverhampton, on July 17, August 18, and September 5; four from the Crystal Palace, viz., on July 30, August 20, September 1, and September 8; and one from Mill Hill, near Hendon, where the balloon had fallen the night before, and where it had been anchored during the night. In the ascent on July 17, a height of 26,177 feet was reached; and in the descent a mass of vapour of 8000 feet in thickness was passed through, so dense that the balloon was not visible from the car. In that of August 18, an altitude of 11,500 feet was attained; then the balloon descended to 3200 feet; then ascended to 23,400 feet, where a consultation took place, and it was decided not to go higher, as clouds of unknown thickness and moisture had to be passed through. In the ascent on August 20, the air was almost calm; the balloon for a long time hovered over the Crystal Palace, and then over London, whilst it was lighted up, where they seemed to be destined to remain all night; finally, went above the clouds, and came down at night near Hendon. The balloon was then anchored for the night, the lower valve being closed with the hope that the gas would be retained. Before sunrise, on August 21, all the instruments were replaced and the balloon left the earth: it was a warm, dull, cloudy morning; clouds were reached at the height of 5000 feet; the light rapidly increased, and gradually the balloon emerged from dense clouds into a basin surrounded with immense black mountains of cloud, rising far above; shortly afterwards there were deep ravines of grand proportions below, bounded with beautiful curved lines. The sky was blue with cirri. The tops of the mountain-like clouds became silvery and golden; at the height of 8000 feet we were on their level, and the sun appeared flooding with golden light all space for many degrees both right and left, tinting with orange and silver all the remaining space. It was a glorious sight. As the sun's rays fell on the balloon we rose more rapidly, each instant opening to us ravines of wonderful extent, and presenting elsewhere a mighty sea of cloud. Here there were shining masses in mountain chains, some rising perpendicularly from the plains, dark on one side, and silvery and bright on the other, with summits of dazzling whiteness; some there were of a pyramidal form, a large portion undulatory, and in the horizon Alpine ranges bounded the view. A height of nearly three miles was reached. On September 1, when at the height of three-quarters of a mile over London, the whole course of the river Thames was visible from its mouth; and parallel to it, and bounded by its banks, a cloud or fog-bank extended the whole distance, following all its sinuosities. For half an hour before the descent, near Woking, in Surrey, the balloon was under one stratum of cloud and above another; the upper surface of the latter was remarked as bluish white, the middle portion the pure white of the cumulus, and the lower surface a blackish white, and from which rain was falling on the earth. The balloon descended to a height of 1300 feet, but still above these clouds. It was afterwards learnt that rain had been falling from these clouds all the afternoon.

On September 5, the balloon ascended from Wolverhampton: at 29,000 feet from the earth Mr. Glaisher became insensible; the balloon still ascended to fully the height of 35,000 feet or 36,000 feet, and may have gone even higher. Mr. Glaisher recovered his consciousness on descending, when at about the same height as he lost it on ascending.

The author had prepared and exhibited diagrams showing the path of the balloon and temperatures of the air at different elevations for each ascent, and extensive tables of all his observations. From these he deduced the following table, showing the mean temperature of the air at every 5000 feet of elevation above the level of the sea in each high ascent:—

Height above the Level of the Sea.	Mean Temperature of the Air. July 17.	August 18.	August 21.	September 5.	Mean.	Decrease of Temperature for an Increase of Height of 5000 feet
Feet.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.
0	61·2	69·6	62·0	62·2	63·8	...
5,000	39·7	48·0	43·3	41·4	43·1	20·7
10,000	28·0	40·7	32·0	31·0	32·9	10·2
15,000	31·0	31·1	19·0	21·0	25·7	7·2
19,500	42·2	...	...	...	...	...
20,000	33·0	25·9	...	10·6	23·2	2·5
25,000	16·0	23·9	...	0·0	13·3	9·9
30,000	...	...	...	−5·3	...	...
Decrease of Temperature for an Increase of Height of 25,000 Feet.	44·9	45·7	...	62·2	50·5	...

The results on July 17 are perfectly anomalous. Up to 10,000 feet the decrease accords with the other days of experiments; but from 10,000 feet the results are perfectly surprising, and continue so up to more than 20,000 feet. Above 25,000 feet they are again accordant. If we suppose that up to 10,000 feet and again at 25,000 feet the results are not abnormal, by continuing the curve joining these two portions, and then reading, we should have the following readings:—viz., at 0 feet the mean temperature was 61°·2; at 5000 feet, 39°·7; at 10,000 feet, 27°·5; at 15,000 feet, 22°·7; at 19,500 feet, 20°·0; at 20,000 feet, 19°·5; at 25,000 feet, 16°·3. Then the measure of disturbance would be as follows:—At 10,000 feet, 0°·5 in excess; at 15,000 feet, 8°·3 in excess; at 19,500 feet, 22°·2 in excess; at 20,000 feet, 13°·5 in excess; at 25,000 feet, 0°·3 in defect. The numbers in the last column of the table show that the average decrease of temperature in the first 5000 feet exceeds 20°, and in the next 5000 feet is but little more than 10°. The numbers in the lowest line of the table show that the average decrease of temperature for 25,000 feet is 51° nearly. From these numbers it seems that two-fifths of the whole decrease of temperature in 5 miles takes place in the first mile, and therefore that the decrement is not uniform with the increment of elevation. The author then discussed the observations up to 1 mile in all the eight ascents. The table on next page shows the mean temperature of the air at every 1000 feet up to 5000 feet on the days of the balloon ascents.

From this table we learn that the mean decrease of temperature of the air exceeds 21° for the first mile, and from the last column that the rate of the decrease of temperature in the atmosphere is not uniform up to 5000 feet. These results are based upon observations including clear and cloudy states of the sky: in the former the differences would be larger, and in the latter they would be smaller. The author then spoke upon the electrical state of the air, which he found charged with positive electricity, decreasing in amount with elevation. With respect to ozone, he said none was shown in the earlier ascents, but that large quantities were shown in the latter, and attributed the

deficiency in the former to bad paper. He remarked, that diminished pressure exercised a very different influence upon different individuals, dependent probably upon temperament and organization; that the effect of high eleva-

Height.	July 17.	July 30.	Aug. 18.	Aug. 20.	Aug. 21.	Sept. 1.	Sept. 5.	Sept. 8.	Mean.	Effect of 1000 ft.
Feet.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.	Deg.
0	61·2	70·0	69·6	66·8	62·0	67·0	62·2	69·7	66·1	...
1000	57·0	63·0	62·0	62·0	58·0	59·8	57·8	65·0	60·6	5·5
2000	52·6	56·8	56·5	57 0	54·0	53·2	53·0	60·4	55·4	5·2
3000	48·3	52·2	53·3	52·7	50·3	49·2	48·7	55·7	51·3	4·1
4000	44·0	49·8	50-4	49·0	46·9	47·7	45·0	51·5	48-0	3·3
5000	39·7	47·0	48·0	45·0	43·3	46·0	41·4	48·4	44·8	3·2
Effect of an Elevation of 5000 feet.	21·5	23·0	21·6	21·8	18·7	21·0	20·8	21·3	21·3	...

tion was different upon the same individual at different times; that the time of vibration of a magnet was somewhat longer at high elevation than on the earth; that different notes and sounds pass more readily through the air than others, instancing that the barking of a dog can be heard two miles high, and the shouting of a multitude not one mile.

The author concluded his paper with the following remarks:—These eight ascents have led me to conclude, First, that it was necessary to employ a balloon containing nearly 90,000 cubic feet of gas; and that it was impossible to get so high as 6 miles, even with a balloon of this magnitude, unless carburetted hydrogen, varying in specific gravity from 370 to 340, had been supplied for the purpose. It is true that these statements are rather conflicting when compared with those made by one or two early travellers who professed to have reached some miles in height with small balloons. But if we recollect that at 3¾ miles high a volume of gas will double its bulk, we have at once a ready means of determining how high a balloon can go; and in order to reach an elevation of 6 or 7 miles it is obvious that one-third of the capacity of the balloon should be able to support the entire weight of the balloon, inclusive of sufficient ballast for the descent. The amount of ballast taken up affords another clue as to the power of reaching great heights. Gay-Lussac's ballast, as before mentioned, was 33 lb. Rush and Green, when their barometers, as stated by them, stood at 11°, had only 70 lb. left; and this was considered sufficient *playing* power. We found that it was desirable to reserve 500 or 600 lb.; and although we could have gone much higher by saving less, still on every occasion it was evident that a large amount of ballast was indispensable to regulate the descent and select a favourable spot with the nicest accuracy. Secondly, it was manifest throughout our various journeys that excessive altitude and extended range as to distance are quite incompatible. The readings of the instruments establish this; and it has been pointed out what a short time the balloon held its highest place, and how reluctantly it appeared to linger even at a somewhat less elevation. This was not owing to any leakage or imperfection in the balloon itself, for its efficiency has been well tested, and it remained intact a whole night without the least perceptible loss of gas. It has been stated by an aeronaut of experience that strong opposing currents have been heard to produce an audible contention and to sound like the "*roaring of a hurricane.*" Now, the only deviation we experienced from the most perfect stillness was a slight whining noise in the netting, and this only when the balloon was rising with great rapidity. The balloon itself, as it descends, flaps about occasionally; but this occurs when it is in a collapsed state, and very likely it was under similar circumstances, and perhaps during a rapid descent, that the flapping of the lower part of the balloon was mistaken for a roaring wind. I may also state that the too readily accepted theory as to the prevalence of a settled west or north-west wind was not confirmed in our trips; nor was the appearance of the upper surface of the clouds such as

to establish the theory, that the clouds assume a counterpart of the earth's surface below, and rise or fall like hills and dales. The formation of vapour along the course, and during an ascent from the Crystal Palace, has already been alluded to: this was a very remarkable demonstration.

The principal results deduced from these observations may be briefly stated. That the temperature of the air does not decrease uniformly with height above the earth's surface, and that, consequently, more elucidation upon this point is required, particularly in its influence on the laws of refraction. That an aneroid barometer can be made to read correctly, certainly to the first place, and probably to the second place of decimals, to a pressure so low as 5 inches. That the humidity of the atmosphere does decrease with the height, with a wonderfully increasing rate, till at heights exceeding 5 miles the amount of aqueous vapour in the atmosphere is very small indeed. That we now can answer the question I put in my opening remarks, and can say that observations up to three miles high, even of a delicate nature, can be made as comfortably in a balloon as on the earth; that at heights exceeding 4 miles they cannot be made quite so well, because of the personal distress of the observer; that at 5 miles high it requires the exercise of a strong will to make them at all. That up to 3 miles high any person may go into the car of a balloon who is possessed of an ordinary degree of self-possession. That no person with heart-disease or pulmonary complaints should attempt 4 miles high. But, at the same time, it must be borne in mind that it is concluded that the balloon is properly handled. It has been fortunate for this Association and myself that we have had the assistance of Mr. Coxwell, who has the experience of more than 400 ascents, based upon knowledge of natural philosophy, and that he knows "the why and because" of all his operations; and it was this fact, which I saw immediately from the clearness of his explanation to me for each operation, that enabled me to dismiss from my mind all thoughts of my position, and to concentrate my whole energies upon my duties. In conclusion, I feel certain that if these experiments prove that the balloon is available for philosophic research, then one of the brightest links in the long chain of useful works, performed through the agency of the Association, will be the feeling that the balloon in proper hands may be made a powerful philosophic agent.

There was next read the Report of the Proceedings of the Balloon Committee, by Colonel Sykes, who, as chairman of the Balloon Committee, stated "that he held in his hand a record of the proceedings of the Committee, comprising all resolutions of the Committee, and copies of the correspondence with Sir John Herschel, the Astronomer Royal, and others. He would not detain the meeting by reading *in extenso* the proceedings, but confine himself to some prominent points. The Committee was originally appointed by the Association at Manchester, with a grant of 200*l*. In the first instance a balloon was hired of Mr. E. T. Smith, the proprietor of Drury Lane Theatre and Cremorne Gardens. Wolverhampton being centrically situated in England, and with the probability of the longest run in any wind, was selected as the most fit place for the ascents, the first of which was appointed for the 22nd of March. During the process of inflation, however, it was found necessary to patch up a number of holes, the balloon showing evident signs of leakage. He (Col. Sykes) himself patched up about twetny holes. Nevertheless, the balloon ascended and disappeared from view in a cloud; but within half an hour it unexpectedly collapsed, and came down within seven miles of Wolverhampton. It was then found that there had been a considerable aperture at the top, which could not be seen while the inflation was proceeding; and there could be no doubt, therefore, as no injury had occurred in the transit,

that the balloon was sent from Cremorne in a defective state. On that occasion 57,000 feet of gas were uselessly expended. We then put ourselves into communication with Mr. Coxwell, who in the course of six weeks built a balloon larger than any which had been seen in England. Its dimensions were—height, 69 feet; diameter, 54 feet; comprised of 46 gores, each of 44 inches; and the balloon was capable of holding 95,000 cubic feet of gas. Unhappily, an accident occurred. On the 30th of June the balloon was being inflated at Wolverhampton, when a gust of wind tore the ring from out of the balloon, and the consequence was, a rent took place from the bottom to the top, and the magnificent object collapsed, of course, and 58,000 feet of gas were lost. These facts were stated in order to show why the Committee called upon the Association for an additional grant. On the 17th of July, however, a successful ascent was made from Wolverhampton; another on the 18th of August; and on the 5th of September the memorable ascent was made which carried Mr. Glaisher and Mr. Coxwell to between seven and eight miles from the earth, and which gave occasion to the manifestation of such resolution and indomitable courage on the part of Mr. Glaisher and Mr. Coxwell. In all 329,000 cubic feet of gas had been expended, of which 115,000 cubic feet had been lost. The total expenditure had been 270*l*." The hon. and gallant gentleman concluded by saying "that the Committee, after the experience of the several ascents which had taken place, deemed it proper to express their opinion, that as all the observations hitherto made under the authority of the British Association had, owing to unavoidable circumstances, been confined to the autumnal period of the year, there should be a repetition of observations during other periods, with a view to test the normal character of the observations already made; and they recommended that the Balloon Committee should be re-appointed, with a grant of 200*l*., which would suffice to cover all probable expenses of the ensuing year."

SECULAR COOLING OF THE EARTH.

PROFESSOR WILLIAM THOMSON in a communication to the Royal Society of Edinburgh, says:—The fact that the Temperature of the Earth increases with the depth below the surface, implies a continual loss of heat from the interior by conduction outwards, through or into the upper crust. Since the upper crust does not become hotter from year to year, there must, therefore, be a Secular loss of Heat from the whole Earth. It is possible that no cooling may result from this loss of heat, but only exhaustion of potential energy, which, in this case, could scarcely be other than chemical affinity between substances forming part of the earth's mass. But it is certain that either the earth is becoming, on the whole, cooler from age to age, or that the heat conducted out is generated in the interior by temporary dynamical action (such as chemical combination). To suppose, as Lyell has done, that the substances combining together, according to the chemical

hypothesis of terrestrial heat, may be again separated electrolytically by thermo-electric currents due to the heat generated by their combination, and thus the chemical action and its heat continued in an endless cycle, violates the first principles of natural philosophy, in exactly the same manner and to the same degree, as to believe that a clock constructed with a self-winding movement, may fulfil the expectations of its ingenious inventor by going for ever.

Adopting as the more probable, the simpler hypothesis that the earth is merely a heated body cooling, and not, on the whole, influenced to any sensible degree by interior chemical action, the author applies Fourier's theory of the conduction of heat to trace the earth's thermal history backwards. From data regarding the specific heat and thermal conductivity of the earth's substance, he investigates the time that must elapse from an epoch of any given uniform high temperature throughout the interior, until the present condition of underground temperature could be reached. Taking into account the very uncertain character of the data when high temperatures are concerned, he infers that most probably either the whole earth must have been incandescent at some time from 50,000,000 to 500,000,000 years ago, or that at some less ancient date, but still anterior to the earliest human history, there must have been up to the surface a temperature above the boiling point of water. Either alternative—or indeed any theory whatever consistent with the principles of natural philosophy regarding previous conditions of the earth—is as decisive against the views of those naturalists who acknowledge no creation of life on the earth within fathomable periods of time, as the plainest elements of dynamics are against those who maintain that we have no evidence in nature of an end.—*Edinburgh New Philosophical Journal.*

COSMOGONICAL SPECULATIONS.

Dr. I. Ashe, in a paper read by him to the British Association, has objected to the opinion that the solar system had ever been gaseous in condition or globular in form, as then its present nearly planiform condition could not have been assumed. He stated facts and arguments which, in his opinion, proved that secular cooling could not have brought it, if gaseous, to its present condition ; but that it was originally composed of particles having cohesion, he considered proved by the heavier matter being all towards the centre (the sun), and the lighter planets off towards the confines ; and he inferred that the system was originally a liquid plane, or rather consisted of two rings, from one of which the inner, and from the other the outer, planets were formed; asteroids being probably formed from small independent portions of matter between the two rings. His ideas were very speculative, and chiefly analogical, as to the formation of each planet, and the origin of their respective motions of rotation on axes; as to their motions in their orbits, that he seemed to derive from original rotations impressed on the rings themselves.

The author then examined the particular question of the formation of the earth, dissenting from the geologists, especially on the question of the origin of the saltness of the sea.

IRON FORMED BY ANIMALCULES.

THE *Journal de l'Instruction Publique* contains a curious article by M. Oscar de Watteville, in which he announces the fact, not generally known, that in the lakes of Sweden there are vast layers or banks of Iron, exclusively built up by Animalcules, not unlike those that have laid the foundations of large islands in the ocean, by silently and for ages cementing matter with matter, so as to create those beautiful forms known as madreporæ, milleporæ, corals, &c. The iron thus found is called in Sweden lake ore, distinguished according to its form, into gunpowder, pearl, money, or cake ore. These iron banks are from 10 to 200 mètres in length, from 5 to 15 broad, and from a fourth to three-fourths of a mètre and more in thickness. In winter, the Swedish peasant, who has but little to do in that season, makes holes in the ice of a lake, and with a long pole probes the bottom, until he has found an iron bank. An iron sieve is then let down, and with a sort of ladle, conveniently fashioned for the purpose, the loose ore is shovelled into the sieve, which is then hoisted up again. The ore thus extracted is, of course, mixed with a quantity of sand and other extraneous matter, which is got rid of by washing it in a cradle, like that used by gold-diggers. A man may get out a ton of iron ore per day by this process.

PRESSURE CAVITIES IN TOPAZ, BERYL, AND DIAMOND.

SIR DAVID BREWSTER, in a paper read to the Royal Society of Edinburgh, gives a brief account of the various phenomena of fluid and gaseous Cavities which he has discovered in Diamond, Topaz, Beryl, and other minerals. He describes—

1. Cavities with two immiscible fluids, the most expansible of which has received the name of *Brewstolyne*, and the most dense that of *Cryptolyne*, from the American and French mineralogists.
2. Cavities containing only one of these fluids.
3. Cavities containing the two fluids, and also crystals of various primitive forms, some of which melt by heat and recrystallize in cooling.
4. Cavities containing gas and vapour.

The author states that the first class of cavities exist in thousands, forming strata plane and curved, and intersecting one another at various angles, but having no relation to the primitive and secondary planes of the crystal. From these facts he draws the conclusion that the minerals which contain them are of igneous origin; and he considers this conclusion as demonstrated by the existence of what he calls *pressure cavties*, which are never found in crystals of aqueous origin. These microscopic cavities, which are numerous in diamond, exist also in topaz and beryl. The gas

which fills them has compressed by its elastic force the substance of the mineral around the cavities, as shown by four sectors or quadrants of light which it polarizes; consequently the mineral must have been in a soft or plastic state by fusion when it thus yielded to the pressure of the included gas.

THALLIUM.

A REPORT on the discovery and properties of this new metal has been read by M. Dumas to the Academy of Sciences at Paris. M. Dumas says, "No one contests that Mr. W. Crookes was the first to see (on March 30, 1861) the characteristic green ray of Thallium in the spectrum produced by the residuum of certain specimens of selenium, which he had found in the products of a piece of Lipari sulphur and in some Spanish pyrites, and that he signallized and named thallium a new elementary body. No one, on the other hand, can contest that M. Lamy was the first who isolated thallium, and established that it is not a metalloid analogous to tellurium and selenium, as Mr. Crookes thought, but a true metal." We have no space to go into further details of the controversy, but add, that M. Dumas remarks that "thallium is destined to make an epoch in the history of chemistry by the astonishing contrast which it exhibits between its chemical characters and physical properties. It is no exaggeration to say that, with regard to the classification of the metals generally received, thallium offers a union of contradictory properties which justify its being termed the paradoxical metal, the ornithorhynchus of metals." Among the alkaline metals, thallium is placed at the opposite extremity of a scale of which lythium constitutes the first term, and of which the equivalent weight marks the different degrees. These weights are:—Lithium, 7; sodium, 23; potassium, 39; rubidium, 85; cæsium, 123; thallium, 204.—*Illustrated London News.*

RUBIDIUM.

THIS rare alkaline metal, discovered by M. Bunsen in certain mineral waters by means of the spectrum analysis, has been found by Grandeau in the ashes of beetroot, tobacco, coffee, tea, and grapes. The spectrum of tobacco gave bands characteristic of lime, lithium, potassium, and rubidium. These facts show that Rubidium is one of the most widely-diffused bodies in nature, since vegetables of the most diverse kinds are found to take it up from the soil. This opens a field of research in vegetable chemistry into which M. Grandeau proposes to enter.

RUBIDIUM AND CÆSIUM.

M. SCHRÖTTER, the eminent Austrian chemist, has affirmed the presence of these new metals in the mica of Zinnwald, in Bohemia. M. Seybel, proprietor of chemical works at Liesing, near Vienna,

has operated upon 800 lb. with the view of extracting the oxides of these metals. The mica has been placed in contact with lime, and the mass resulting from the mutual action has been washed. The residuum has given carbonate of lithium and five ounces of the chlorides of Rubidium and Cæsium in a state of perfect purity. This mica contains nearly 3 per cent. of the oxides of these two metals, which is a more considerable proportion than is known at present in any other substance. M. Seybel is engaged in making arrangements for the production of these interesting substances in larger quantities, so as to render them accessible to all interested in chemical pursuits.

ATTRACTION AND ADHESION.

THE phenomena of Attraction and Adhesion, as exhibited in solid bodies, films, liquid globules, &c., have been investigated by Mr. Richard Norris, whose paper on the subject appears in the *Proceedings of the Royal Society*, from which we extract a few experiments. These Mr. Norris prefaces by reminding his readers that it has long been observed that solid bodies floating on liquids modify the figure of the surface of the liquid; pieces of tinfoil or greased bodies depress the liquid around them, whilst other bodies elevate it, giving rise to small mounds of liquid bounded by concave lines; likes attract likes, and repel unlikes, &c. He states that the following experiments are arranged to show that these effects of attraction are not peculiar to floating bodies, and that the only requirement is that the liquid should be associated with the bodies in which the movement occurs. 1. Let two balls of sealing-wax, or other material of greater specific gravity than water, be suspended by hairs in such a manner that they will both be partially immersed in water to an equal extent, the points of suspension being at a little distance apart, and the suspending hairs consequently parallel. When brought within the proper range they will attract each other in the same manner as the floating bodies. In doing so they necessarily describe a small arc of a circle, of which the suspending hair is the radius, and have, therefore, not simply moved towards each other in a horizontal line, but have been raised to a higher level. 2. Suspend moveably, by means of a thread passing over a pulley and a counterbalancing weight, a horizontal cork disc, from the under surface of which a drop of water is hanging. On a support beneath, formed by three upright pins, place a small piece of paper or thin glass, on the surface of which there is also a drop of water. On depressing the disc until the two drops of water touch each other, the paper or plate will be instantly drawn up to it; or, if the plate at the bottom be heavier than the disc, the latter will be drawn down. 3. When a soap bubble is allowed to fall on an irregular surface, such as a piece of lint or flannel, it maintains its spherical shape; but if a smooth surface, such as a sheet of glass, be brought into slight contact with it, the wall of the bubble will be immediately

attracted and flattened out upon it. In like manner, when two bubbles come in contact by their convex surfaces and cohere, the cohering surfaces become flattened, and the bubbles in a group cohere by plane surfaces.—*Illustrated London News.*

DEFLECTION OF THE PLUMMET CAUSED BY THE SUN'S AND MOON'S ATTRACTION.

MR. EDWARD SANG, in a paper read to the Royal Society of Edinburgh, shows that the attraction of the Sun causes a Deflection of the Plummet, having its maximum about the 240th part of a second, and proportional to twice the size of the sun's zenith distance; the deflection is at its maximum when the sun is 45° above or below the horizon, and occurs in the vertical plane passing through the attracting body.

The deflection due to the moon has its maximum about the 60th part of a second, and follows the same law; it is toward or from the attracting body according as the zenith distance is less or more than 90°.

Upon the cross-level of a transit instrument, the joint effect is to cause a semi-diurnal oscillation, small at the quarters and rising to the 24th part of a second at new and full moon; while the influencé upon meridian observations is sufficient to cause a disagreement between the greatest inclination of the moon's orbit, as observed at St. Petersburg and Madras, amounting to the 50th of a second.

The general conclusion drawn was, that we cannot determine the positions of the heavenly bodies true to the 100th part of a second, without having made allowance for this source of disturbance.

THE EARTH AND THE MOON.

PROFESSOR HENNESSEY has read to the British Association a paper on some characteristic differences between the configuration of the surfaces of the Earth and Moon. He pointed out that the peculiarities observed on the surface of our satellite could be ascribed to the sole action of volcanic forces, whereas those which we find on the earth result from a combination of volcanic and atmospherical agencies. In order more perfectly to study these contrasts he called attention to the most characteristic feature of all lunar volcanoes, namely, the ring or hoop-shaped crater, surrounded by circular or nearly concentric ridges. On the earth's surface volcanoes deviated more or less from this type, and if the deviations be due to the differences between terrestrial and lunar superficial forces, it must follow that such differences will be most distinctly manifested in those cases where such terrestrial forces possess the highest degree of energy. He illustrated this proposition by referring to the peculiar structure of the volcanoes in the island of Java, where the action of tropical rains and hurricanes has been effective in producing the very widest differences

between the terrestrial volcanic summits and those observed on the moon's surface. Instead of the hooped structure of the latter, we see at Java specimens of radiating ribs, like those of a folded lamp-shade, or an umbrella half closed—an appearance due to the very regular manner in which the tropical torrents scoop out the friable and scoriaceous summits of the craters.

MEASUREMENT OF THE EARTH.

LIEUTENANT-GENERAL BAYER, says the *Kreutz Zeitung* of Berlin, who has rendered a great service to science in executing, in concert with the astronomer Bessel, the survey of Prussia, has lately proposed a new trigonometrical operation for ascertaining the exact Size and Form of the Earth. It would be necessary to measure exactly a section comprised between the parallels of Palermo and Christiana on the one hand, and the meridians of Kœnigsberg and Bonni on the other. This proposition has been approved of by the Prussian Government, which has invited the states comprised in the section to participate in the work. Conferences will be opened in a few days between the delegates of the states which have given their consent. Austria will be represented by General de Fligely, M. de Littrow, and Professor Herr.—*Mechanics' Magazine.*

THE FIGURE OF THE EARTH.

A CURIOUS corollary on the work of Mr. Gumpach, of Jersey, and on the correspondence which took place between him and Mr. Airy, the Astronomer Royal, has transpired in the French Academy of Sciences; which, says *Galignani*, "has received a communication from Mr. Leverrier, on the determination of the longitude of Havre; in which the author, after commenting on the difficulties attending the operation, remarks that the latitude of a point on the earth's surface, determined by geodetic operations, often differs so considerably from those obtained by astronomical observations as to induce one to attribute them to the irregularity of the terrestrial spheroid. Hence Mr. Leverrier strongly recommends the remeasurement of the differences of longitude between the extremities of the earth's parallels, so necessary to the exact determination of the figure of our globe. We are here," adds *Galignani*, "forcibly reminded of Mr. de Gumpach's work, which we have already mentioned; and we think that Mr. Leverrier's explicit admission of the ambiguity of the latitudes hitherto determined goes far to prove Mr. de Gumpach's arguments in favour of the prolate and not oblate figure of the terrestrial spheroid."

GEOMETRICAL CURVES.

AN instrument for describing Geometrical Curves, invented by Mr. H. Johnston, has been described and exhibited to the British

Association, by the Rev. Dr. Booth. This instrument supplies a want which has been felt by architects and sculptors. By its help, geometrical spirals of various orders may be described with as much manual facility as a circle may be drawn on paper by a common compass. It is needless to give the mathematical investigations of the various curves that may by its help be described, as they will appear in the *Transactions* of the Association.

SECTIONS OF CUBES.

A PAPER has been read to the British Association "On some Models of Sections of Cubes," by Mr. C. M. Willich. These are carefully executed models, designed to illustrate certain simple propositions in solid geometry relative to the volumes, &c., of solids formed by the section of a cube by planes. The author wishes, at the same time, to place on record the simple fraction $\frac{148}{167}$, which gives an extremely close approximation to the side of a square equal in area to a circle of which the diameter is unity.

CAPILLARY ATTRACTION.

THE Capillary Attraction of Paper has been employed by M. Schönbein in chemical analysis. He employs in his researches leaves of unsized white paper, suspended at right angles above the surface of the liquid. They are plunged into the liquor to the depth of two or three millimètres, and remain so till the liquor rises to the height of three centimètres. M. Schönbein's experiments show that alkaline, acid, and saline solutions have different degrees of action. For example, potash, iodide of potassium, and water are imbibed with different degrees of rapidity. The water rises before the others; the iodide of potassium follows, and the potash comes last. Details will be found in the *Repertoire de Chimie.*

LIQUIDS IN THE SPHEROIDAL STATE.

M. DE LUCA has sent to the French Academy of Sciences an account of his researches relative to the temperature of water thrown into vases greatly heated, which lead him to conclude that there is nothing remarkable in the phenomena presented by liquids when so treated, and that the Spheroidal Form they assume is in perfect accordance with the ordinary laws of physics.—*Comptes Rendus.*

A NEW METHOD OF FORMING SOAP-BUBBLES

HAS been discovered by M. Felix Plateau, son of the philosopher of Ghent, so eminent for his optical researches, during which he lost his sight, but who, nevertheless, is still ardently continuing his labours. In a letter in the *Cosmos* his son states that one day when throwing into the garden some liquid on which

they had been experimenting, he endeavoured to do it so as to form a sheet of water in the air. He not only accomplished this, but was surprised to see a bubble of about 3 in. diameter slowly descending. He immediately repeated the experiment with soap and water, and obtained sometimes as many as fifteen bubbles at a time, of smaller size when numerous. The following he found to be the best conditions:—A vessel in the form of a capsule about 4 in. or 5 in. broad, well filled with liquid, which should be thrown at an angle of about 45 degrees, turning rapidly, so as to produce the most extended sheet possible. The liquid which he found most successful was formed of 1 part of Marseilles soap in 40 parts of water. The elder Plateau sees in this phenomenon an argument in favour of the vesicular form of the vapour of the clouds, supposing that the particles of water exist as strata of various figures and curvatures, which may be formed into vesicles by movements in the atmosphere.—*Illustrated London News.*

DEVELOPMENT OF HEAT, SOLAR AND TERRESTRIAL.

PROFESSOR TYNDALL, in a lecture "On Force," at the Royal Institution, treats of the Development of Heat; and it is to the wonderful conclusions to which men of science have come on this subject, that we would more especially direct the attention of our readers; although the mere abstract law of the conversion of mechanical force into heat, and, *vice versâ*, of heat into mechanical force, has long been known and treated of. Having first considered this law in various of its bearings, the Professor proceeded:—

Whence is the sun's heat derived, and by what means is it maintained? No combustion, no chemical affinity with which we are acquainted, would be competent to produce the temperature of the sun's surface. Besides, were the sun a burning body merely, its light and heat would assuredly speedily come to an end. We have already regarded the case of a body falling from a great distance towards the earth; and found that the heat generated by its collision would be twice that produced by the combustion of an equal weight of coal. How much greater must be the heat developed by a body falling towards the sun! The maximum velocity with which a body can strike the earth is about seven miles in a second: the maximum velocity with which it can strike the sun is 390 miles in a second. And, as the heat developed by the collision is proportional to the square of the velocity destroyed, an asteroid falling into the sun with the above velocity would generate about 10,000 times the quantity of heat generated by the combustion of an asteroid of coal of the same weight. Have we any reason to believe that such bodies exist in space, and that they may be raining down upon the sun? The meteorites flashing through the air are small planetary bodies, drawn by the earth's attraction, and entering our atmosphere with planetary velocity. By friction against the air they are raised to

incandescence and caused to emit light and heat. At certain seasons of the year they shower down upon us in great numbers. In Boston, 240,000 of them were observed in nine hours. There is every reason to believe that space is stocked with smaller masses, which obey the same laws as the large ones. That lenticular envelope which surrounds the sun, and which is known to astronomers as the Zodiacal light, is probably a crowd of meteors; and, moving as they do in a resisting medium, they must continually approach the sun. Falling into it, they would be competent to produce the heat observed; and this would constitute a source from which the annual loss of heat would be made good. The quantity of matter competent to produce the necessary effect would, during the range of history, produce no appreciable augmentation in the sun's magnitude. The augmentation of the sun's attractive force would be more appreciable.

Our earth moves in its orbit with a velocity of 68,040 miles an hour. Were this motion stopped, an amount of heat would be developed sufficient to raise the temperature of a globe of lead of the same size as the earth 384,000 degrees of the centigrade thermometer. It has been prophesied that "the elements shall melt with fervent heat." The earth's own motion embraces the conditions of fulfilment: stop that motion, and the greater part, if not the whole, of her mass would be reduced to vapour. If the earth fell into the sun, the amount of heat developed by the shock would be equal to that developed by the combustion of 6435 earths of solid coal.

To whom, then, said Professor Tyndall, are we indebted for the striking generalizations of this evening's discourse? All that I have laid before you is the work of a man of whom you have scarcely ever heard—a German physician, named Mayer. Led by his own beautiful researches, and quite independent of Mayer, Mr. Joule published his first paper on the "Mechanical Value of Heat," in 1843; but in 1842 Mayer had actually calculated the mechanical equivalent of heat from data which a man of rare originality alone could turn to account. You will desire to know what has become of this man. His mind gave way: he became insane; and he was sent to a lunatic asylum. He recovered, however; and, I believe, is at this moment a cultivator of vineyards in Heilbronn.—*From the "Builder."*

RECENT RESEARCHES ON RADIANT HEAT.

In the *Philosophical Magazine* for April will be found some remarks by Professor Magnus, of Berlin, in relation to Dr. Tyndall's remarkable experiments on the transmission of Heat through gases. Professor Magnus states that he has endeavoured by repeating the experiments to obtain the same results as Dr. Tyndall, but in vain. In a paper immediately following, Dr. Tyndall explains his own experiments in detail, pointing out where he conceives them to differ from those of Professor

Magnus, and thus considers his own results to be fully substantiated. Both papers will be read with attention by those interested in this new field of scientific research.

NEW REGULATOR FOR TEMPERATURES.

A COMMITTEE of the French Academy of Sciences reports very favourably of a new automatic Temperature Regulator which M. Eugene Rollaud has attached to his mechanical roaster; and which, the Committee say, has worked for eight years with the precision of a piece of physical apparatus and the certainty of a practical machine. The combustion of the furnace is regulated by balance valves on the pipes through which the air is introduced, which valves are automatically governed by the regulator. This regulator consists of a mercury gauge, the closed branch of which is attached to a fixed support, while the cistern is freely suspended to the beam of a balance; the varying weight in this branch will cause the beam to assume different positions depending on the temperature of the apparatus, which variation of position may be used to govern the valve. In order to prevent the barometric changes from affecting the apparatus, the closed end of a syphon barometer, the tube of which is of the same diameter with the gauge, is attached to the beam, while its cistern is sustained by the fixed support. The barometric changes will then affect these two instruments equally and in opposite directions, and will, consequently, have no effect on the position of the balance beam.—*Comptes Rendus.*

ANIMAL-HEAT THERMOMETER.

DR. JONATHAN OSBORNE has described this new instrument in the *Dublin Quarterly Journal of Medical Science.* The following is the principle on which it is used:—

The bulb, being heated up to 90 deg. Fahr., represents the heat of the surface of the human body; when in this state it is exposed to a cooler medium (air, water, or moist air), and allowed to cool to 80 deg.; the time required for cooling these ten degrees represents (inversely), by means of a graduated scale, the cooling power exerted by that medium wherever derived. Placed as men are, generally in a medium under 80 deg., they are always undergoing a process of cooling. In our ordinary clothing we feel just comfortable at 56 deg. in-doors; but when exposed to a current of air, even at the same temperature, we feel cool in proportion to the force of the current, or to the conducting power imparted to it by increased moisture. These are agencies of which the common thermometer takes no notice. Its indications are by the expansions or contractions of a fluid, which always maintains the same temperature as the surrounding medium. The living animal, on the contrary, as always maintaining a temperature of its own, and as constantly resisting cooling agencies, is not to be considered as thus passively submitting. When heated to 90 deg., the rapidity with which it is cooled, depending on the intensity of the cooling influences, furnishes an index to their combined effect. It does not depict the force of any one acting singly, but gives the sum of them acting simultaneously. Dr. Osborne suggests the following as advantages of his thermometer:—1. It shows the conducting power of air and water; 2. The cooling effects of currents in the surrounding media of air and water; 3. The effects of wind, hitherto unheeded by the ordinary thermometer; 4. The refrigerating

effect of air admitted into apartments from open windows; 5. To what degree the heat derived from an open fireplace is accompanied by a cooling process from the current of air rushing towards the fire; and 6. The cold and heat of climates as actually felt by human beings. This subject will no doubt be duly investigated by meteorologists.

COMBUSTION OF GUNPOWDER IN VACUO, AND IN GASEOUS MEDIA.

M. Bianchi has laid before the French Academy of Sciences a *résumé* of the principal results of his experiments on the Combustion of Powder in Air, and in various Gaseous Media.

The apparatus used consists of a glass globe, in which, by a socket, and by means of a screw-thread, a support penetrates which can be adapted to the air-pump. This support is traversed by two metallic rods with clamps, well insulated and intended to receive a small crucible formed of platinum wire about half a millimètre in diameter, rolled in a conical spiral and closed by a cover, also formed of platinum wire. In this crucible the powder is placed. By means of a battery of three or four Bunsen's elements, the platinum wire, which constitutes the crucible, is heated to redness. The principal facts observed may be summed up in the following phenomena :—

1. Ordinary powder, fulminates, and all gunpowders, in grains or in compact masses, placed freely *in vacuo*, that is to say, in a great space as compared with the volume of the powder, and submitted to the sudden action of a heat of more than 2000°, burn slowly and without producing, as in air, a brisk deflagration.

2. On the contrary, when the powder is enclosed in a pistol and also exhausted, and is ignited by means of a platinum wire raised to redness, or, better, by a percussion cap, it explodes as rapidly as in air.

3. *In vacuo* the combustion of gun-cotton takes place slowly in successive layers, commencing by the parts nearest the source of heat: once commenced, it continues until the gun-cotton completely disappears, without its being in contact with the incandescent focus; lastly, this combustion takes place without producing light, even in the greatest darkness.

4. The products of combustion are not the same as in air.

5. The combustion of powder takes place in nitrogen, carbonic acid, and other gaseous media unfit for combustion, with a rapidity and briskness almost equal to that in air.—*Comptes Rendus; Philosophical Magazine*, No. 162.

THERMIC PROPERTIES OF WATER AND STEAM.

Professor Macquorn Rankine, in a paper read to the Royal Society of Edinburgh, refers to the general equation of the mechanical action of heat which Professor Christison and he arrived at independently, by different methods, in 1849, and points out that the form of that equation which was laid before the Society by him in 1850 comprehends, as a particular case, the law which connects the volume of a given weight of Steam, with its temperature, pressure, and latent heat. He describes the use of that law, with proper numerical data, to compute, in the absence of direct experiment, tables of the density and volume of saturated steam, more accurate than those founded on the assumption of the perfectly gaseous condition, as exemplified in tables which he published in 1855 and subsequently. Referring next to the direct experiments

of Messrs. Fairbairn and Tate on the density of steam, published in the *Philosophical Transactions* for 1860, he gives a tabular comparison of the volumes of one pound of steam as determined by these experiments, and as computed theoretically from M. Regnault's experiments on the latent heat of steam, with the aid of Joule's mechanical equivalent of heat; and from that comparison he draws conclusions which may be summed up as follows:—

1. At temperatures below 212°, the differences between the results of theory and experiment are inappreciable.
2. At temperatures above 212°, the differences, although too small to be of any consequence in practical calculations connected with steam-engines, are appreciable, the volume of a pound of steam by theory being slightly greater than by experiment.
3. Small as those differences are, there exist no known sources of error either in the data of the theoretical calculation or in the method of experimenting sufficient to account for them.
4. They are therefore most probably caused by some unknown difference in the molecular condition of the steam in M. Regnault's experiments on latent heat, and in Messrs. Fairbairn and Tate's experiments on density.
5. That difference of condition is probably connected with the fact, that in M. Regnault's experiments the steam was in rapid motion from a boiler towards a condenser; whereas in the experiments of Messrs. Fairbairn and Tate the steam was at rest.
6. Further experimental researches are desirable.

SURFACE OF THE SUN.

Mr. J. Nasmyth has read to the British Association a short but interesting sketch of the character of the Sun's Surface as at present known. He described the spots as gaps or holes, more or less extensive, in the luminous surface or photosphere of the sun. These exposed the totally dark bottom or nucleus of the sun; over this appears the mist surface—a thin, gauze-like veil spread over it. Then came the penumbral stratum, and over all, the luminous stratum, which he had had the good fortune to discover was composed of a multitude of very elongated, lenticular-shaped, or, to use a familiar illustration, willow-leaf-shaped masses, crowded over the photosphere, and crossing one another in every possible direction. The author had prepared and exhibited a diagram, pasting such elongated slips of white paper over a sheet of black card, crossing one another in every possible direction in such multitudes as to hide the dark nucleus everywhere, except at the spots. These elongated lens-shaped objects he found to be in constant motion relatively to one another; they sometimes approached, sometimes receded, and sometimes they assumed a new angular position, by one end either maintaining a fixed distance or approaching its neighbour, while at the other end they retired from each other. These objects, some of which were as large in superficial area as all Europe, and some even as the surface of the whole earth, were found to shoot in thin streams across the spots, bridging them over in well-defined streams or comparative lines, as exhibited on the diagram; sometimes by crowding in on the edges of the spot they closed it in, and frequently, at length,

thus obliterated it. These objects were of various dimensions, but in length they generally were from ninety to one hundred times as long as their breadth at the middle or widest part.

AUTOGRAPHS OF THE SUN.

At the late meeting of the British Association, Professor Selwyn showed several "Autographs of the Sun," taken with his "heliautograph," by Mr. Titterton, photographer, Ely; which consists of a camera and instantaneous slide, by Dallmeyer, attached to a refractor of $2\frac{3}{4}$ inches aperture, by Dollond; the principle being the same as that of the instrument made at the suggestion of Sir J. Herschel, for the Kew Observatory; and the Professor expressed his thanks to Mr. Balfour Stewart and Mr. Buckley for their advice. The autographs are of July 25, 26, 28, 29, 31; August 1, 2, and August 4, 10.15 A.M. and 11.30 A.M. (a series of bright days coincident with a large group of spots); August 19, 20, 23 and 25, where the same group reappears much diminished; September 19, 23, 26 and 30, in which is seen a group of 118,000 in length. On the 23rd three autographs were taken, two of them with the edge of the sun in the centre of the photographic plate, showing that the diminution of light towards the edges of the disc is a real phenomenon, and not wholly due to the camera. In the two of the 4th of August, where the great spot (20,000 miles in diameter) appears on the edge, a very distinct *notch* is seen, and the sun appears to give strong evidence that the spots are cavities; but eye observations and measurements by the Rev. F. Howlett and others tend to show that this evidence is not conclusive, for there was still a remaining portion of photosphere between the spot and the edge. The phenomena shown in these autographs appear to confirm the views of Sir J. Herschel, that the two parallel regions of the sun where the spots appear, are like the tropical regions of the earth, where tornadoes and cyclones occur, and those of Wilson in the last century. The *faculæ* seem to show that the tropical regions of the sun are highly agitated, and that immense waves of luminous matter are thrown up, between which appear the dark cavities of the spots, whose sloping sides are seen in the penumbræ as explained by Wilson and others. Other analogies between solar spots and earthly storms were pointed out, and reference was made to the glimpses of the structure of the sun exhibited by Mr. Nasmyth as confirming the above views.—*Athenæum.*

SUNSHINE ON THE TORRID ZONE.

A paper has been read to the British Association—"On the Relative Amount of Sunshine falling on the Torrid Zone of the Earth," by Professor Hennessey. By the aid of transformations of formulæ given by Poisson, the area of that portion of the equatorial regions of the earth which receives as much sunshine as the rest of the earth's surface is ascertained. This area at

the outer limits of the earth's atmosphere is thus found to be bounded by parallels situate at distances of 23° 44′ 40″ at each side of the equator; hence the amount of sunshine falling on the outer limits of the earth's atmosphere between the tropics is very nearly equal to that which falls on the remaining portions of the earth's surface. If we reflect that, according to Principal Forbes's researches, the amount of heat extinguished by the atmosphere before a given solar ray reaches the earth is more than one-half for inclinations less than 25°, and that for inclinations for 5° only the twentieth part of the heat reaches the ground, we immediately see that the torrid zone of the earth must be far more effective than all the rest of the earth's surface, as a recipient of solar heat. It follows, therefore, that the distribution of the absorbing and radiating surfaces within the torrid zone must, upon the whole, exercise a predominating influence in modifying general terrestrial climate.

THE SOLAR CAMERA.

MR. CLAUDET has read to the British Association a paper "On the Means of following the Small Divisions of the Scale regulating the Distances and Enlargement in the Solar Camera." Mr. Claudet, in a former paper, had proposed a new method for measuring both the distances of the negative and screen for any degree of enlargement of the image, by means of a scale or unity divided in 100 parts, and smaller fractions if possible. This scale being fixed on the table of the optical apparatus, an index connected with the frame holding the negative was brought exactly on any division of the scale which was indicating the proportion and distance of the image. This arrangement would be very complete and satisfactory if the scale were always long enough to be marked with divisions sufficiently conspicuous; but the shorter the focus of the object-glass, the smaller the divisions of the scale must be. In order to meet this difficulty, Mr. Claudet has, in this paper, adopted a plan. (See *Athenæum* Report for details.)

SWIFTNESS OF THE PROPAGATION OF LIGHT.

FAILING sight prevented Arago from carrying out his idea of measuring the velocity of light by Breguet's arrangement of the whirling mirror, employed by Wheatstone in 1834 to determine the swiftness of the propagation of electricity. The subject was taken up by M. Fizeau, and still later by M. Foucault, who employed steam power instead of clockwork to give motion to the mirror. The latter has lately resumed his researches, and has presented to the Academy of Sciences the preliminary results of his observations:—In place of the number 307 millions of mètres per second for the Swiftness of the Propagation of Light hitherto admitted in accordance with Delambre, who deduced it from the satellites of Jupiter, M. Foucault finds 298 millions of mètres, the difference

being about one thirty-fourth of the whole. The details of the calculations will be anxiously looked for by mathematical astronomers.—*Illustrated London Ne*

REFLECTING PLATE.

THE Rev. Dr. Pritchard has given to the British Association a sketch of the construction and effect of the Reflecting Plate of glass as suggested by Sir John Herschel. Its most important office was that it sent off from the eye of the observer 98 per cent. of the sun's heat, which before was so intense as frequently to break the obscured glass, by which his eye had been protected, so suddenly as to endanger loss of sight. Now the observer was placed in the most absolute security, and could at pleasure moderate the light reflected to the eye-piece; inasmuch that he assured the Section that, with a very moderate telescope, whose object-glass was not more than 3 or 4 inches aperture, the willow-leaved objects of which the sun's luminous surface seemed entirely composed, and which had been first discovered by Mr. Nasmyth, and the discovery of which he looked on as a most important epoch in the study of the physical constitution of the sun, could be seen distinctly and studied at leisure. The whole difficulty lay in first seeing them: as soon as that was once got over, he assured the members of the Section that none of them would feel the slightest difficulty in seeing and studying them and their relative motions. Some of the most extraordinary objects had a surface larger than that of the entire earth. Mr. Nasmyth assured the Section that he felt more proud of some of the too flattering observations of Dr. Pritchard than if an order of knighthood were conferred upon him. Mr. Brooke suggested whether these willow-leaved objects might not be produced by diffraction caused by the numberless minute ridges which even the finest polishing powder and process must leave upon the surface of the best polished glass. Dr. Pritchard and Mr. Nasmyth gave several reasons proving this not to be their source; especially their changes of relative position were entirely incompatible with such a supposition.

SPECTRAL RESEARCHES.

MITSCHERLICH has contributed to Poggendorff's *Annalen* an article on Spectrum analysis, in which he describes a method for obtaining a constant and intense coloured flame of any particular substance.

A tube closed at the top, but drawn out and somewhat bent upwards at the bottom, contains a solution of the substance to be investigated. The shape of the tube is like that of a Cooper's mercurial receiver. In the drawn-out part a bundle of very fine platinum wires is placed, projecting somewhat out of the tube. This platinum wire is placed in the flame of a Bunsen's burner, and the bundle of platinum wires, in virtue of capillary attraction,

remains filled with the liquid, which replaces that which has been evaporated. When the tubes have been in use some time, the bundle of wires becomes choked up with substance, which thereby prevents the absorption of any more. To retain the capillarity, acetate of ammonia is added to the solutions to be examined. This, on burning, disperses the substance under investigation, thereby producing an intense and constant flame. A mixture of 20 parts of a solution of 15 per cent. of acetate of ammonia, and one part of the strongest solution of the salt, is found to be the best. Attention must be paid to the position of the platinum wires, in order that neither too much nor too little liquid reaches the flame.

A series of such tubes containing different substances may be arranged on a stand like those on which pipettes are supported, and brought at pleasure into the flame. The apparatus when not in use may be placed under a glass jar, so as to protect the solutions in the wires from evaporation. The size of the vessels used by Mitscherlich gave a flame which was perfectly bright and lasted for two hours.—*Philosophical Magazine*, No. 164.

Mr. Attfield, Director of the Laboratory of the Pharmaceutical Society, has communicated to the Royal Society the results of his examination of various flames containing Carbon. He finds that certain rays of light are common to ignited oxycarbons, hydrocarbons, nitrocarbons, and sulphocarbons, and concludes that these common rays are those emanating from ignited carbon vapour. By special manipulation he obtains the carbon-spectrum with olefiant gas, cyanogen, carbonic oxide, and bisulphide of carbon. Observed by the naked eye, the prevailing colour of the ignited carbon is light blue.

In some "Remarks on the Complementary Spectrum," read to the British Association, by Mr. J. Smith, he endeavours to explain, on the principle adopted by him in his chromatrope experiments, the well-known fact that the spectrum of a hole in the window-shutter, when received on a screen, has the violet end above and the red below, but when looked at through the prism, the red appears above and the violet below.

Prof. H. E. Roscoe, in his concluding lecture "On Spectrum Analysis," delivered at the Royal Institution, began with some details of the observations of Faraday, Wheatstone, Stokes, Foucault, Plücker, Miller, and especially the Swedish philosopher Angström, who had pointed out that the rays which a body absorbs are precisely those which it emits when rendered luminous. Beautiful diagrams of various spectra obtained by several of the above-named philosophers were shown as illuminated by the electric light. These discoveries have been applied by Kirchhoff to the ascertaining the physical constitution of the sun. He pointed out that the dark lines in the solar spectrum correspond in position and thickness with the bright-coloured bands in the spectra obtained from the flame of the combustion of certain metals, especially of iron, where sixty different-coloured bands correspond with sixty of

Fraunhofer's lines. These dark lines Kirchhoff attributes to the absorption of the coloured light by the luminous gases which produce them, in conformity with the optical law, that gases emitting light of different degrees of refrangibility have the power of absorbing the same kind of light. This was illustrated by means of a large gas-flame. When a tube containing heated sodium vapour was placed between the flame and a white screen, hardly any shadow appeared: the white light passed through the luminous sodium vapour without being absorbed; but when the gas-flame itself was coloured by sodium vapour a dark shadow was visible on the screen—the light of the vapour was absorbed. Generalizing from his researches, Kirchhoff considers that the body of the sun is in a high state of incandescence, and that part of the light in passing through the surrounding atmosphere is absorbed by the luminous vapours of the substances of which the body of the sun is composed, the spectra of which vapours are thus represented in the solar spectrum by dark lines; and he states that he has ascertained by analysis that the body of the sun contains iron, nickel, calcium, sodium, magnesium, barium, copper, and zinc. A translation of Kirchhoff's memoir on this subject, by Professor Roscoe, with coloured engravings, has been published by Messrs. Macmillan.—*Illustrated London News.*

M. Janssen, in the *Comptes Rendus* of the French Academy of Sciences, affirms that he has been enabled to determine in the Solar Spectrum the presence of permanent rays, which ought incontestably to be attributed to the action of the terrestrial atmosphere. Several philosophers (among whom he cites Kuhn, Piazzi Smyth, Brewster, and Gladstone,) have discovered in the spectrum singular bands or rays, which appeared only in the morning or evening, and vanished when the sun attained a certain height above the horizon. The temporary character of these bands caused them to be generally considered accidental. "Now," says M. Janssen, "it is incontestable that, if there exist in the solar spectrum bands due to the electric absorption of the gases of the terrestrial atmosphere, these rays must remain there permanently, and present merely variations of intensity in respect to the thickness of the layer of air traversed." To ascertain this he has constructed a new spectroscope, by the aid of which he has been enabled to follow, moment by moment, from sunrise to sunset, groups of bands always visible, varying only in intensity in accordance with the height of the atmosphere. This height being badly known, does not permit the results to be determined with certainty. M. Janssen announces that he will publish his researches *in extenso,* when completed by the study of the positive spectra of nitrogen and oxygen, obtained by the spark of induction or atmospheric electricity.

THE FRAUNHOFER LINES IN THE SOLAR SPECTRUM

Form the subject of a leading paper in the *Philosophical Magazine,* No. 158, by M. Angström, who, in a paper published last year on

the absorption of light, made use of Euler's principle, that the particles of a body, in consequence of resonance, absorb principally those ethereal undulatory motions which have been previously impressed on them, extending the validity of the principle to light, heat, and chemical decomposition. He also conversely endeavoured to show that a body in a state of glowing heat emits just the same kinds of light and heat which it absorbs under the same circumstances. To test this proposition, he performed a series of electric-light spectrum observations. The results he obtained were, that the electrical spectrum (the subject of the researches of Fraunhofer, Wheatstone, and Mason) must be considered as the superposition of two spectra, the one belonging to the metal of which the electrodes are made, the other to the gas through which the spark passes; also that, on account of the different appearance of the lines in the metallic spectrum, it is possible to distinguish it from that arising from the gas. In his present paper, M. Angström gives the results of a new series of experiments performed by means of improved apparatus, his object being—

1. A new examination of the solar spectrum, a determination of the lengths of the waves—not only for the seven principal lines already determined by Fraunhofer, but also for a sufficient number of intermediate lines—and the construction of accurate drawings of the spectrum, without which measurements can have no practical utility. 2. The determination of the length of the waves for the various sorts of light which enter into the gas spectra, of different metals, a determination which is best effected by actually introducing these latter into the solar spectrum. In the paper will be found descriptions of the spectra given by calcium, aluminium, manganese, barium, and other metals; mathematical formulæ of the wave lines, and remarks on fluorescence.

A practical application is likely to be made of the beautiful results of spectrum analysis in the casting of steel. In the new process of melting the metal, it is important to know the exact moment at which to shut down the cover of the furnace; time must be allowed for the escape of the gaseous products which are injurious to the steel, but if that time be prolonged, an injurious effect of another kind is produced. To meet this contingency, it has been proposed to test the gases as they fly off by means of the spectroscope; and as soon as the particular colour is observed peculiar to the gas which begins to escape at the moment the molten metal is in proper condition, the manufacturer will then have an infallible sign of the proper moment for closing the furnace.

THE MICROSCOPES IN THE INTERNATIONAL EXHIBITION

ARE well described in the *Journal of Microscopical Science.* It is gratifying to learn that in the opinion of the writer a very great advance has been made in the general style and elegance of the instruments exhibited, resulting from the accurate adjustment of parts to their purpose, and the great attention paid to the illumination of objects, and the construction of object-glasses—viz., in the amplification of the aperture and the definition and detection

of minute surface markings. The foreign courts, it is said, produced nothing to compare with the productions of English opticians. The principal exhibitors were well known—Mr. Ross, Messrs. Smith and Beck, Mr. Baker, Mr. Field, Mr. Highley, &c. An engraving is given of Mr. Pillischer's universal microscope. Neat portable microscopes were exhibited by Dr. Beale and others. The numerous specimens of binocular microscopes were mostly on the construction of Mr. Wenham, to whom we owe the supply of this important desideratum.

NEW TELESCOPE.

A NEW Telescope at the Imperial Observatory, Paris, has been described by M. Léon Foucault in a note read at a recent meeting of the French Academy of Sciences. For several years past he has endeavoured to construct large parabolic reflectors of silvered glass. He has at last succeeded in obtaining one with a diameter of nearly 80 centimètres, which forms its principal focus at 4·50 mètres. This mirror, mounted in a Newtonian telescope, and provisionally carried by an altazimuthal foot, has worked well for three months at the Observatory, where it has been well tried: therefore M. Foucault now considers that a mirror of this size is a reality acquired for the service of astronomy. Further details are given in the *Comptes Rendus*.

IMPROVEMENT IN TELESCOPES.

A NEW "Aplanatic" Eyepiece for Telescopes, invented by Mr. Thornthwaite, of Newgate-street, has been described in the "Notices" of the Royal Astronomical Society by Mr. T. W. Burr. Mr. Thornthwaite had improved the orthoscopic microscopic eyepiece, by substituting an achromatic plano-convex lens for the meniscus. The eyeglass, in his modification, consists of a double convex crown-glass lens and a plano-concave of flint-glass, forming a combination similar to one of the pairs of an achromatic microscope objective; and this construction (the field-glass remaining a crossed double convex) preserves the advantage of a large and flat field, with better definition and freedom from colour, which has induced the inventor to call it the "Aplanatic" Eyepiece. Mr. Burr having employed this form in a microscope, decided to adopt it in his telescopic experiments, which, with the aid of Mr. Thornthwaite, he has effected with success. When looking at the sun or moon, at least one-third more of the disk of each body was visible with this eyepiece than with the corresponding Huyghenian. A similar advantage was obtained in examining the planets and clusters of stars, such as Pleiades, Presepe, and others. Small stars were brought up by the increase of power and light, without losing the advantage of a large field; and in the great nebula of Orion the effect was very beautiful, allowing the employment of a power which before was disadvantageous, as it made the object dim and contracted the field, which is now large and the nebula brilliant.

A GREAT TELESCOPE.

MR. ALVAN CLARK, of Cambridge, Mass., has constructed an Achromatic Telescope, said to be the largest in the world. The glass has a focal distance of 23 feet, and a diameter of 18 inches. The glass resolves the sextuple star Thera, one Orionis, which is regarded as a severe test. It must be regarded as the best possible evidence of the superior quality of the object-glass that it has served to discover the minute companion star so close to the overpowering brilliancy of Sirius. A defect in the material or workmanship would be very sure to cause a dispersion of light, which would be fatal to its visibility. It remains to be seen whether this will prove to be the hitherto invisible body long disturbing the motions of Sirius, the existence of which has long been surmised from the investigations of Bessel and Peters upon the irregularities of its proper motion in right ascension.—*American Paper.*

THE LARYNGOSCOPE.

PROFESSOR CSERMAK, of Prague, has exhibited this novelty at the Royal Institution. The instrument consists of a concave mirror, by which the light of a lamp or the daylight is thrown upon a small plane mirror, which the operator introduces into the posterior part of the cavity of the mouth with its back leaning gently against the uvula so as to form an angle of about 45 deg. with the axis of the neck. The Professor, by a simple contrivance, exhibited his own vocal chords and the interior of the larynx to the spectators, the former regulating and controlling the movements of the vocal chords by the aid of a small plane mirror, in which, while the spectator was looking on, he was enabled to watch the movements himself. The mode in which the chordæ vocales open and close, the appearance of the parts in point of colour and arrangement, and the perfect clearness with which the parts were brought out, were very interesting points. The Professor stated that on several occasions he has been able to see even the bifurcation of the trachea. He also exhibited several photographic views of the interior of the larynx by means of the stereoscope.

NEW OPTICAL INSTRUMENT.

THERE has been read to the British Association, a "Description of an Optical Instrument which indicates the Relative Change of Position of Two Objects (such as Ships at Sea during night) which are maintaining Independent Courses," by Mr. J. M. Menzies. This instrument consisted of a lantern-shaped case, containing a lens or eye in front, and a concentric sheet of bent glass behind, at the focal distance of the lens ruled with parallel vertical lines. This was hung up so as to have its axis parallel to the course of the vessel, and the bright spot, the image of the lights of the approaching vessel, showed by its position and shifting the relative place and course of the approaching vessel.

THE VOLTAIC ARC.

THE sounds and the phenomena of motion which take place within the Voltaic Arc form the subject of a memoir laid before the Academy of Sciences, at Vienna, by M. Reitlinger. In his experiments he has employed Trevelyan's apparatus, put in motion by a galvanic current, according to Mr. Page's process. He states that the series of metals, as to their faculty of producing sounds, differs from that resulting from the experiments made with the apparatus having heat for its motive power. As to the tearing motion consequent on the discharges, the results obtained by both apparatus are identical. Experiments made under water, and with combinations of bismuth and antimony, or yellow copper, have proved that the exception made by Prof. J. D. Forbes in favour of the first of these metals is only apparent. These combinations manifest different action according to the direction of the current, and the sounds increase in intensity when the current passes from the bismuth to the antimony, or yellow copper—a circumstance which agrees with the refrigerating or heating effect of Peltier's experiment. Experiments made under the receiver of the air-pump showed that there is no effect from the expansion of the air in consequence of these discharges. M. Reitlinger believes that the sum of these experiments gives a great probability to the supposition that the sounds emitted by the galvanic apparatus of Trevelyan, as well as by the motion of the globes of Mr. Gore, proceed from the mechanical effects of the discharges, and specially from the tearing action. The sounds emitted by open tubes of laminated metal placed on metallic supports, considered in relation to the acoustic phenomena observed by Poggendorff, seem to him also to support the hypothesis which he has put forth.—*Illustrated London* ;

ON ADJUSTING THE NEEDLES OF A GALVANOMETER.

IN making or adjusting an astatic Galvanometer, the difficulty of magnetizing two needles to exactly the same intensity frequently causes the expenditure of much time and trouble, which, Mr. J. Broughton states, may be greatly reduced by the following simple method of procedure :—

Let the two needles be as nearly as possible of the same dimensions; a piece of watch-spring will make a good pair for a large instrument. Then, after strongly magnetizing them, suspend each singly by a piece of fine silk, and producing a definite deflection by means of a magnet, allow the needle to return to rest, counting the number of oscillations it makes in a constant time (say 1¼ minutes). The needle that makes the greater number will be the more highly magnetized, and will probably require, as the case may be, a very slight touch with the similar pole of a magnet in order to reduce its magnetism to the intensity of the other needle, which can be readily managed after one or

two trials in the above manner. When the two needles are subsequently superposed with opposed poles, and finally suspended with the lower one between the coil, the pair will be found to retain but little polarity. The needle whose directive force still preponderates can then be readily detected, should it not already be determined by the position of the pair,—by carefully holding at the distance of about two feet from one end of the pair and equi-distant from each the north pole of a magnet, and noticing whether the two nearest ends are attracted or repelled. Should the former be the case, it will then be the needle whose south pole is nearest the magnet whose magnetism is still in excess, which must be slightly demagnetized by holding for a second the north pole of a magnet at the distance of two or three inches from that of the needle. By proceeding in this manner and by noticing the deflections produced by a weak current, as that of a single thermo-electric pair, the needles may be quickly rendered astatic, which will be indicated by the extreme slowness of their oscillations and by resting equatorially.—*The Chemical News.*

INFLUENCE OF THE MAGNET ON THE ELECTRIC DISCHARGE.

M. PLUCKER, of Berlin, whose memoir on this subject is translated in the *Bibliothèque Universelle* of Geneva, has arrived at these results. He states that the action of the Magnet on the discharge of the induction apparatus which MM. Ruhmkorff and Du Moncel have been the first to recognise, is completely different to that which he has observed, and of which he has endeavoured to establish the laws. "There would be," he says, "an inexplicable contradiction between the two kinds of action if there were no difference in the circumstances in which the two classes of phenomena are produced, which are perfectly identical except in what relates to the density of the surrounding medium. . . . We can, then, enounce this remarkable result—that the action of the magnet on the electric discharge differs essentially according as it is exercised in a very rarefied or in a denser medium—that is to say, the discharge is different in the two cases."

NEW MAGNETO-ELECTRIC MACHINES.

MACHINES said to be constructed on a new principle by Dr. Vander Weyde, of the Cooper Institute, New York, are described and illustrated by diagrams in the Journal of the Franklin Institute of Pennsylvania. In his fourth arrangement he takes two strong horseshoe magnets, having polished cylindrical extremities, and places them horizontally on a board or in a box, touching each other with their opposite poles, which are situated in two coils. These coils, wound of well-insulated copper wire, are immovable, and fixed to the board. One of the magnets must slide in and out of the coil, and may suddenly be separated from the opposite fixed magnet which attracts it by means of a strong lever. The moment this is done the magnetism of the magnets (before made latent by their contact) is suddenly set free, and induces an electric current in the coils; and by joining the magnets again a current will be developed in the opposite direction, which, if desired, may be led in the same direction by means of an appropriate commutator attached to the lever. This machine is said to be peculiarly

adapted for electro-plating, chemical decomposition, medical purposes, electric light, and igniting gas, gunpowder, &c. For the last purpose the machine should be constructed with especial regard to a single but very powerful spark. To obtain this the precautions are—1. To have the magnets carefully rounded off at the poles, well fitting, and exactly filling the opening in the coils. 2. To have the ends well ground on a plane to secure a perfect contact. 3. To insulate the coil carefully in winding it over the glass or india-rubber to prevent the spark from losing its intensity and length by discharging partially through the magnets, as is the case in all other machines; also, to avoid the mistake of having metallic or other conductive rings connected with those coils, which absorb a part of the electric effect of the magnets at the expense of the coils.—*Illustrated London News.*

GUY'S ELECTRO-MOTIVE ENGINE.

MR. G. M. GUY has described to the British Association his Electro-motive Engine. The author explained the difficulty of obtaining, by any of the methods heretofore suggested, a sufficiently rapid motion within the small spaces through which magnets or electro-magnets acted with sufficient energy, and chiefly in consequence of the rapid diminution of that energy as the distance of the poles increased, even by very minute quantities. He exhibited and explained a working model of an engine, in which—by the rotation of a cone of soft iron with a very obtuse angle, caused to roll on successive radial bars, arranged in a plane by the engine itself, when set in motion, caused to be successively electro-magnets with alternately attractive and repelling poles—an axle attached to the bore of the cone by a Hook's joint was made to assume a direct rapid rotatory motion, from which the required power could be taken off in the usual well-known modes. This engine had no dead points, and therefore required no fly-wheel.

NEW ELECTRICAL PHENOMENA.

SOME interesting Electrical Phenomena are described by M. Perrot in a letter to the French Academy of Sciences. In a glass capsule filled with oil, or some other liquid of small conducting power, he mixed by agitation some fragments of gold-leaf floating on the surface. He plunged into the liquid, at a little distance apart from each other, two spherical conductors, one communicating with the electric machine, the other connected with the earth. Immediately after the machine was put in motion currents were seen to form. The particles of gold were carried to the nearest sphere, were repelled from it after contact, and were then directed towards the opposite sphere. When arrived at a certain distance the two opposing currents met, appeared to neutralize each other, and escaped laterally in order to return towards their respective spheres. If the experiment were made in oil or any

viscous liquid, the particles disposed themselves in lines as regular as those formed by iron filings round the poles of a magnet. When the tension was weak the lines formed by the particles of gold which departed from the two spheres reunited and emitted a spark which illuminated the whole length of the line on which it occurred. M. Perrot states that he has thus obtained, under feeble electric tension, sparks a hundred times longer than those obtained directly from the machine. The position of the neutral line or surface arising transversely between the two electrized spheres depends on the relation of their surfaces. If the spheres be equal the neutral surface is formed in the middle of the distance which separates them. If a point be opposed to a sphere the neutral surface is established very near to the latter.—*Ibid.*

THERMO-ELECTRIC CURRENTS.

A PROVISIONAL Report on Thermo-electric Currents in Circuits of one Metal, has been read to the British Association by Mr. F. Jenkin, who first gave a short description of the Electrical Currents to which he had drawn the attention of the Association at their previous meeting, as due to loose contacts between two unequally heated wires of one metal. Experiments were then described with loose contacts between wires of two dissimilar metals. The great intensity of the currents so obtained, compared with the ordinary thermo-electric currents from metallic contact between the two metals, was pointed out; and it was shown that an analysis of the results proved, beyond doubt, that the currents were of the same nature as those produced by unequally-heated metals placed in an electrolyte: the thin films of melted oxides of copper and iron constitute this electrolyte with unequally-heated junctions at surface of the two wires. This theory requires that the oxide of copper should be considered far more positive than iron, and the oxide of iron far more negative than copper. Direct experiments with oxides of iron and copper between platinum wires confirmed this conclusion. It was, however, still considered doubtful how far electrolytes could be included in a true thermo-electric scale. It was stated that Sangoni had, in 1853, anticipated some of these results. A suggestion was then made that the current observed by Magnus and others at the first metallic contact of unequally-heated wires of one metal may be due to the fact that the electrical quality of a perfectly homogeneous metal does not depend solely on its temper and temperature, as has been hitherto supposed, but to some extent on the time during which it has been maintained at that temperature; a fact proved, as regards electrical resistance, by Mr. Mathiessen. In support of this view, it was stated that the currents obtained from these metallic contacts are not instantaneous, as generally supposed, but continue for, at least, five minutes after contact has been made, gradually diminishing from a maximum to zero.—*Athenæum.*

ELECTRICAL TENSION.

MR. L. CLARK has described to the British Association at length the instrument, founded on the unit of one cell of Daniell's battery, by which he was led—during the time he was conducting some experiments for the British Government on the phenomena which present themselves in connexion with the manufacture and working of submarine telegraph cables—to examine the Tension or potential of force of electrical currents under various conditions, and thus led to some new and very interesting investigations of the properties of the voltaic couple, and some equally new experiments on the tensions at different points in the voltameter. The author concludes, from an examination of the intensity of the current at the zinc, at the copper, or platina, &c. plate, and at several points of the liquid interposed, that the entire force is developed at the zinc, and the copper, &c. plate is only of use as a collector and conductor.

INDUCED ELECTRIC CURRENT.

SOME properties of the Induced Electric Current, elicited by the experiments of Professor Rijke, of Leyden, have been communicated by him to the *Philosophical Magazine*. The mode in which an inducing current is broken exercises a considerable influence on the striking distance of the current, and the experiments of Fizeau and Poggendorff show that whatever tends to diminish the electric density at the place where the circuit is broken exerts a favourable influence on the length of the spark. Considering the fact that every conductor instantly loses electricity when placed in contact with flame, M. Rijke was led to think that it would be possible to increase the striking distance of an induced current by effecting the interruption of the current in the middle of a flaw. The experiments he describes confirmed his views. Atmospheric air and the flames of alcohol, hydrogen, and coal-gas were employed as media. The action of alcohol flame was far inferior to that of hydrogen and coal-gas, which two produced about the same effect. Amongst their results he found that the influence of the flame was less perceptible when the experiment was so arranged as to obtain a greater striking distance; that the hottest part of the flame did not exert the greatest influence, but the contrary; that gas not lighted produced an action but little less than that of flame; and that the length of the induction spark increased considerably when the rupture of the inducing circuit took place in air in rapid motion.

ELECTRIC CONDUCTIVITY.

MR. MATHIESSEN and M. Von Bose have been experimenting "On the Influence of Temperature on the Electric Conductivity of the Metals." They state, in the *Proceedings of the Royal Society*, that they "have deduced from the results obtained the law that all pure metals in a solid state vary in conducting power

to the same extent between 0 deg. and 100 deg. cent., and that metalloids conduct electricity better when heated than when cold."—*Illustrated London News.*

ELECTRICAL RESISTANCE.

THERE has been read to the British Association, by Mr. Fleming Jenkin, a "Provisional Report on a Proposed Standard of Electrical Resistance," from a Committee appointed by the Association, and consisting of Profs. A. Williamson, C. Wheatstone, W. Thomson, W. H. Miller, Mr. A. Mathiessen, and Mr. F. Jenkin. Five qualities were enumerated as desirable in the proposed standard :—1st. It should be of convenient magnitude. 2nd. It should form part of a coherent system for general electrical measurement. 3rd. It should bear a definite relation to the unit of work. 4th, It should be unalterable. 5th. It should be reproducible.—None of the units hitherto proposed fulfilled all of those conditions. Those based on an arbitrary length and section, or weight of some arbitrary material, did not possess the second and third qualities. The absolute system possessed these, but failed in the fourth and fifth qualities. A system proposed by Sir C. Bright and Mr. Latimer Clark failed in the third point. The Committee could not, therefore, recommend the unqualified adoption of any of the units hitherto proposed. They recommend that a material standard should be prepared of such form and materials as would ensure the most absolute permanency: that this standard should approximate very nearly to 10^{10} absolute $\frac{\text{meter}}{\text{seconds}}$ (this magnitude does not differ by more than 3 per cent. from Dr. W. Siemens's mercury unit); that, instead of being called the absolute unit, it should be known as the unit of 1862, or by some simpler name; but from time to time, as the advance of science renders this possible, the difference between this unit and the true ten millions of $\frac{\text{meter}}{\text{seconds}}$ should be ascertained with increased accuracy in order that the error resulting from the use of the 1862, in dynamical calculations, instead of the true absolute unit, may be corrected by those who require these corrections; but that the material standard itself shall, under no circumstances, be altered in substance or definition. Before carrying out these views, the Committee felt that they should be in a position to secure a very considerable approximation to the absolute unit, and to ensure great permanency in the material standard. The experiments connected with these two points are in progress, and it is hoped that before Christmas the fresh determination of the absolute unit, checking Professor Weber's results, will be completed, and that provisional standards may then be distributed to all who require them. Reports from Professor Williamson and Mr. Mathiessen were appended, and letters from Professor Kirchhoff,

Dr. W. Siemens, and Dr. Esselbach; and also a description of an accurate apparatus for the adjustment or multiplication of resistance coils designed by Mr. F. Jenkin.—*Builder.*

SPECTRUM OF THE ELECTRIC SPARK IN COMPOUND GASES.

Mr. J. M. Seguin has read to the French Academy of Sciences a note upon this subject:—

When the spark traverses the fluoride of silicium in a test-tube reversed over mercury, a very beautiful blue illumination is produced. This appears in the spectrum as a large vivid blue ray, very far from the green. The fluoride of boron (which contains a little of the fluoride of silicium) gives the same results. M. Seguin thinks, therefore, that we may attribute the blue ray of the spectrum to the fluorine, for M. Plücker does not point it out among those which he has seen in the rarefied vapour of chloride of silicium. The bands mentioned by him are a red, an orange, three greens, and a blue; three proceeding from the chlorine and the three others probably from the silicium. "The aspect of the electric spark," says M. Seguin, "testifies to its chemical action. It is slender when there is no reaction, and the bands of the spectrum are then very distinct. When a combination or decomposition is effected, the spark is enveloped with a halo and the spectrum bands are less distinct. The distinctness of the bands may be favoured by multiplying the solutions of continuity in the conductors of the discharge, and the spark may be rendered more voluminous by adding weight to the hammer of the interrupter. The substitution of the slender form of the spark for the voluminous is a sign that the reactions are terminated. In the decomposition of a highly-carburetted gas the spark resembles a flame, and, probably on account of the large quantity of incandescent particles, the spectrum appears like that of the white part of ordinary flame. When the gas is almost decomposed, as the hydrogen is disengaged and carbon deposited on the electrodes, the spark becomes slender, and we see the bands of hydrogen and the bands appertaining to hydro-carbons and to carbon itself. These simple observations should not be neglected in the interpretation of these experiments."—*Comptes Rendus.*

POTABILIZATION OF SEA-WATER BY THE ELECTRIC CURRENT.

In *Macmillan's Magazine* has appeared an interesting paper by Dr. Phipson, entitled, "Electricity at Work," in which the author passes in review the useful applications of this wonderful agency. He concludes his paper as follows:—"Reflecting upon the powerful decomposing chemical force with which we are furnished by the electric current, it occurred to me that I might be able to render sea-water potable by decomposing and extracting its salt, by means of a moderately powerful battery. The experiments were made at Ostend a few years ago. My apparatus consisted of three vessels containing sea-water; the centre one contained the water to be operated upon, the two others communicated with the two poles of the battery. The three vessels were connected by two bent ∩-tubes filled with sea-water. As the only battery I could procure in Ostend was rather weak, I passed the current through the water for about fourteen hours, after which one of the outside vessels had become acid and the other alkaline. The sea-water was then filtered through charcoal, and was nearly drinkable. It would have been, I doubt not, quite potable had the battery employed been more powerful, as it was

I found it difficult to extract the last particles of salt; and the water after subsequent trials, still presented a slightly brackish taste. I have not had an opportunity of repeating this experiment since, but from the results obtained, I think it probable that sea-water may be rendered potable by means of the electric current."

FIRING CANNON BY ELECTRICITY.

THIS new mode of Firing Cannon, is called Electro-telegraphic, and has been practised at the camp of Chalons, in presence of commissioners selected from the superior officers of artillery. The following is an explanation of the new system. When the firing takes place at a distance of 2000 or 3000 mètres from the object to be struck, it requires a certain time to ascertain the accuracy of the aim. With the system at present under trial at the camp, the indication of the accuracy of the aim is instantaneous, and, if imperfect, it may be instantly rectified. The Emperor was present. The firing commenced, and the experiment proved most successful. The target, formed of planks placed at a considerable distance, was literally riddled with grape-shot. The indication of the precision of the aim was made with great accuracy.

PATENT ELECTRIC BELLS.

THIS invention, of which Messrs. Newall and Co., of Sloane-street, are the sole agents, possesses many great advantages. 1st. It is simple—a battery charged with chemicals is placed in any unappropriated corner of the house to keep company with the gas-meter; two wires are attached to the zinc and copper poles by which the electricity is generated and carried off. These two wires being brought together in any part of the house, cause one or more bells to ring. 2nd. It is inexpensive, as the cost of replenishing the chemicals of a battery large enough for 20 bells does not exceed 5s. a-year. 3rd. It is universally applicable; it can be taken over any uneven wall or floor and in any tortuous direction without affecting the result: it can be applied to the desks of railway stations, banks, or with equal facility to the tables of their managers. 4th. It is easily worked: it can be worked by the faintest pressure of a knob, by a lever, or by almost an infinite variety of methods. 5th. The wires can be coated with silk or cotton of any tint, so as to accord with the decorations of a room, or to be practically invisible upon them; it can be fixed to shutters, doors, and windows at night, and be made to give thence an alarm by, if required, ringing every bell in the house. There seems, in fact, no limit to the usefulness of these electric bells for domestic purposes. They have been already fixed in Windsor Castle and in several other large buildings, where they have given every satisfaction.—*Builder.*

THE ELECTRIC LIGHT.

M. BRACHET has suggested the enclosing the Light in a double globe of glass, the inner one to be of uranium glass, to arrest the chemical rays: the outer of glass of a colour which will absorb the greenish tone of the light transmitted through uranium. The French Academy have referred the subject to MM. Regnault and Babinet.

THE ELECTRIC LIGHT FOR MINING PURPOSES.

MM. DUMAS AND BENOIT propose an apparatus for applying the Electric Light to Mining Purposes, to consist especially of three parts—a battery, a Ruhmkorff's coil, and a Geissler's tube—the whole arranged so as to produce a sufficient light to illuminate the miner, and allow him to work in atmospheres where other lights fail.

The light produced is cold, or rather does not heat the tube in which it is produced; and gas has no access to it; it is quite isolated; the apparatus is as compact as ordinary lamps, and there is no injurious emanation. It can be lighted or extinguished at will. It can work for twelve consecutive hours without diminution, and without requiring any change, the workman having only occasionally to agitate the carbon by means of a rod.

The greatest difficulty consisted in being able to associate a battery of such intensity that the weight of the apparatus was as small as possible, the light produced of the greatest regularity, and its duration at least twelve hours. The present form of the apparatus, which may be still further diminished, is already so small that the miner can carry it without inconvenience, like a small carpet bag.

The authors point out the advantages of such a mode of illumination, and state that the results obtained in using Becquerel's fluor-essence-tubes have led to the expectation that the luminous effects may be greatly improved both as to duration and intensity. —*Comptes Rendus; Philosophical Magazine*, No. 162.

SERRIN'S APPARATUS FOR STREET-LIGHTING BY MEANS OF ELECTRICITY.

PROFESSOR PEPPER has illustrated at the Polytechnic Institution, Regent Street, M. V. L. Serrin's Apparatus for Illuminating Streets, &c., by means of the Electric Light. Of course the application of electricity for illuminating purposes is not a new idea or discovery; the difficulty respecting the application of the imponderable has always been, until M. Serrin's invention, to obtain a sustained light. Many years ago the electric light was exhibited; but it was so intermittent, and so liable to pass the spectator from midday brightness to midnight obscurity, that it could not be depended upon. The apparatus invented by M. Serrin is automatic, takes care of itself, and that so well, that, after the battery is charged, the charcoal-points, upon which the light depends, are retained at a calculated distance apart and consumed, the positive to the negative, in the proportion of 22 to 10. To meet the exigencies of this unequal consumption of the charcoal-

points, much ingenuity was required. There have been some forty contrivances to produce a sustained electric light; but, until that of M. Serrin, none of them were automatic. The experiments made on Tuesday evening were in every way satisfactory. Wires connected with the battery conducted the light instantaneously to those points of the building where the automatic registers had been fixed. A light was exhibited in one of Defries's prismatic lanterns, supplied for the occasion; another was exhibited through a medium of ground glass. The effect of both was pleasing. To gaze upon the bare electric light is painful to the eye, and would never do for street illumination; but seen through the media of prisms or ground glass, the eye can behold it with as little discomfort as a candle or gas jet. The bare electric light is penetrative, and may be perceived at many miles distance, which renders it extremely suitable for night signals and telegraphic purposes. The veiled light is not so penetrative, but is more diffused, and, for lighting up cities, more useful. An experiment was made to show how the electric light can be used in an atmosphere of carbonic acid gas, and how even it can be used under water. The latter experiment was perhaps not so decidedly successful as the other, but still it proves that the electric light can be used under water; and if so, it is easy to see what assistance it is likely to be to the diver in his submarine explorations.—*Mechanics' Magazine.*

PHOTO-ELECTRIC LAMP.

M. DUBOSCQ has recently presented to the French Academy of Sciences a new arrangement of his Photo-electric Lamp, which unites in one the lighting apparatus employed by M. Soleil in his optical experiments, and the electric regulator which by M. Duboscq submitted to the Academy in 1850. This regulator, he says, "is founded on the same principle as that of M. Léon Foucault, but differs from it in its mechanism and its reduced form, which permit its applicability to all the uses of electric light, to the most delicate optical experiments, to theatrical effects, and to illuminating lighthouses and works carried on during the night. It will work either with the voltaic battery or the magneto-electric machine. Two hundred and eighty of these instruments have been delivered by me for various applications in all parts of the world. This regulator is constructed, in fact, to avoid all the losses of light, which have rendered this kind of application very difficult with the old apparatus."—*Illustrated London News.*

ELECTRIC HAIL.

MR. W. R. BOWDITCH has communicated to the *Times* the following account of a storm at Wakefield, on May 7, 1862, illustrative of the theory of Hail propounded by him at the meeting of the British Association at Leeds:—

"The day has been excessively hot for this locality, and the air nearly saturated with moisture; hardly any wind, and the little there was veering about to nearly all points of the compass.

Shortly after 4 o'clock dense banks of black clouds in the south-west betokened an approaching storm, and by 6.30 the storm-clouds so obscured the town that lights were required to enable persons to read or write. A strong wind suddenly sprang up, and at 6.41 a very heavy fall of rain and hail descended. The rain was continuous throughout the storm, but the hail fell in pulses with the increase of the wind. The hailstones, till 6.51, were of transparent ice with an opaque nucleus; their form being that of segments of spheres. During this interval of time I saw no other form, nor were any of the hailstones without the opaque nucleus. The flashes of lightning coincided with the pulses of wind and hail. A short lull followed, during which no hail fell, but at 6.52 fresh hail descended. This coincided in time with the lightning and wind, as the former did, but the hailstones were of all kinds of irregular figures, and all opaque. They resembled lumps of frosted silver. The rain and hail ceased here at 6.58, but the lightning and thunder continued for about a quarter of an hour longer, and while I write a fresh wind from the south-west is blowing. The hail and cold rain beat against my study window and so chilled the glass that it became covered with moisture on the inside, deposited from the air of the room."

METEOROLOGICAL TELEGRAPHY.

At the Royal Institution, Admiral Fitzroy has delivered a lecture, in which he gave "An Explanation of the Meteorological Telegraphy, and its Basis, now under trial at the Board of Trade." Observations, he says, have shown that the currents of air in the atmosphere are regulated by fixed laws. The "law of storms" has been for some time recognised, and their directions have been accurately traced. These great disturbances of the atmosphere are found to be caused by opposing currents of wind, which give the air a rotary motion; and these whirlwinds, or "cyclones," are often of comparatively small diameter. By a careful study of the barometer and thermometer, and of the electrical indicator, called a "storm glass," the state of the weather at any place may be predicted with tolerable accuracy for three or four days in advance. The prognostications of the weather have thus been calculated; and the Board of Trade have, during the past month, sent them to the daily papers. At the beginning of 1861 the Board of Trade commenced the plan of telegraphing, to most of the ports of the kingdom, the forecasts of coming storms, which were based on observed sudden falls of the barometer at distant stations; a fall of the eighth of an inch of mercury in the course of an hour being considered a sure indication of an approaching storm. At first these warnings were disregarded by sailors; but the losses experienced by a storm in February of that year, which had been forecast and signalled, taught them to pay more attention to subsequent signals of danger; and in consequence many ships and numerous lives had been saved.

GUTTA PERCHA.

Mr. Stuart Wortley, in a letter to the *Times*, correcting misstatements made in the House of Commons, that Gutta Percha has failed as an insulating medium, in the experiments made by the Government Commission appointed to consider the subject, says :—

"As a member of the Commission alluded to, and having no interest either in gutta percha or india-rubber, beyond a desire to assist in the selection of the best insulating material for the still greater undertaking of a cable across the Atlantic, I think it desirable that the Government and the public should be cautioned against receiving as authentic these very inaccurate statements.

"The fact is, that the elaborate experiments made under the authority of the Board of Trade showed that, except under very exceptional circumstances, gutta percha was the best insulator, as it was also proved to be impermeable to sea or fresh water under a pressure of 20,000 lb. to a square inch,—equal to a column of water about nine miles in depth.

"So far from gutta percha having failed in submarine lines, I need only refer to the fact that in nearly all the sea-going and oceanic lines now submerged and in efficient working that substance alone is used; and at the late *soirée* at Mr. S. Gurney's house, held to illustrate this subject by corresponding with the most distant parts of Europe, as well as with the coast of Africa, the correspondence was conducted with uniform success and marvellous results, through wires insulated by gutta percha alone."

A NEW TELEGRAPHIC INSTRUMENT,

Remarkable for rapid transmission of messages through long circuits, has been exhibited by Mr. C. W. Siemens, F.R.S., at a conversazione of the President of the Royal Society.

Metal types of a peculiar shape, each type bearing the name of the letter it represents, are set up in brass rods similar to compositors' sticks, well known in printing establishments. These sticks are arranged in front of the telegraph clerk, who sends them one after another through the transmitting instrument. This instrument is worked by magneto-electro-currents, which are generated by a cylindrical iron bar, on which a quantity of insulated copper wire is wound in deep longitudinal grooves. This armature, by means of a fly-wheel, revolves between the poles of a series of twelve permanent magnets. This arrangement has been advantageously applied by Messrs. Siemens, Halske, and Co., for several years for working dial-telegraphs, &c. The receiving instrument is one of Messrs. Siemens, Halske, and Co's. direct working inkwriters, with electro-magnets polarized by magnetic induction. Two currents, a positive and a negative, are required to produce each signal, whether it be a dot or a dash; the former is produced when the interval of time between the positive and negative currents is very short, and the latter when this interval is longer. The code of signals used is that known as the "Morse alphabet." To transmit the message represented by the types, the compositors' sticks are passed under a contact lever, which makes and breaks contact with the line wire when an elevation or depression occurs in the type. Some only of the positive and negative currents generated by the rotating iron armature are passed into the line wire, the other currents generated being short-circuited. The types must always occupy a fixed relative position to the rotating armature, and for this purpose the type-rods are provided with

teeth, by means of which they gear into a screw cut on the revolving spindle of the armature; moreover, recesses are cut on the sides of the type-rods coinciding with the breadth of the teeth, holding the types in certain definite positions. In this manner 400 letters, or 80 words, per minute were transmitted on this occasion through an artificial resistance equal to 3000 statute miles of overground line wire; and it is most remarkable that not the slightest readjustment was required either in the transmitter or receiver, whether the resistance was included in the circuit or taken out. This instrument has been tried by the Submarine Telegraph Company through a circuit consisting of 50 miles of submarine cable (connecting England and France), 800 miles of land line, and 1150 miles of artificial resistance, amounting in all to 2000 miles, when the same speed and certainty of transmission was obtained. Mr. Siemens asserts that this instrument produces the signals with a regularity and certainty unknown in transmission by hand, and excludes the possibility of errors; as the types, after being put in the brass rods, may be easily controlled, by being read over before the message is sent. There seems to be no doubt that the speed of 400 letters per minute may be kept up during the whole day and night continuously; and it appears probable that a line worked with this instrument will be capable of doing as much as eight lines worked with the ordinary instruments. This new system offers the advantage that Government departments, for instance, may have their own type, and compose their own messages, which may transmit conventional codes of signs unknown to any but their correspondents. Mr. Siemens also exhibited a large induction-coil, constructed on a somewhat new principle, in operation. —*Illustrated London News.*

DEEP SEA TELEGRAPH CABLE.

Mr. Duncan has patented a Cable in which he makes use of ratan cane as an external protecting cover to the conducting wire and insulating medium—a material which has not before, we believe, been used for the purpose. This covering is said to be impermeable, and the silicated rind shelters the fibre from the encroachments of animalculæ. The cane has long been in use by the Chinese and Malays, and it can be obtained in large quantities in Lower Bengal, Ceylon, Singapore, and China, of uniform lengths of 50 ft. and upwards. In this cable the joints are dovetailed, scarfed, or spliced, secured with cement, and arranged to fall at intervals, so as to break joint. These joints appear as strong as the cane itself. In paying out the cable, instead of its descending perpendicularly from the ship's side, it will submerge in an even or horizontal position, having sufficient weight to overcome floatation, and cause it to gravitate gradually to the bottom of the ocean. The cane, as a non-conductor, will not generate heat in the hold of the vessel, thus keeping the insulating medium at all times cool and equable, and allowing the tests to be carried on with greater certainty. The following are, among other advantages, claimed by the patentee:—Great flexibility, without elasticity or compressibility; it is not affected by heat or moisture; it is imperishable in sea water; it affords strength and protection to the insulating medium; and it may be manufactured at a price so moderate as to render this cable the cheapest that can be constructed.

GREAT TELEGRAPH FEAT.

The unparalleled Feat of Writing by Telegraph direct through a

continuous line of 3500 miles was recently achieved in the United States. Between 4 and 5 P.M., a news message was sent to San Francisco, to which, a few minutes afterwards, a return message was received, dated San Francisco, Nov. 6, 2¼ P.M. The New York message of 5 P.M. was answered at 2 P.M., or three hours before it was sent, in the usual order of time. The difference in time between the two cities is three hours and fourteen minutes. This, we believe, is the longest circuit ever worked in the history of telegraphing.—*Mechanics' Magazine.*

THE TELEGRAPH TO INDIA.

THE Indian Government have of themselves undertaken this great scheme to establish direct communication between this country and all parts of India; and, in the words of the *Times*, of December 26, 1862, "before this time twelvemonth, the wire will be laid, and London, in point of time, within twelve hours' distance, not only of Bombay, Madras, and Calcutta, but of the furthest limits of our Eastern Indian frontier beyond Rangoon! The India Board have intrusted the entire superintendence and control of the whole plan to Colonel Patrick Stewart, R. E., who has chosen Sir Charles Bright and Mr. Latimer Clark, electrical engineers, for the undertaking and for submerging the line. Every detail is now arranged, and the work begun, and, as we have said, before this day twelvemonth, we shall have our news every morning from India." Two routes have been selected, rather than to rely upon one. The submarine portion of the line will be manufactured with due regard to the recent improvements in the science of telegraphy. The copper conductor is to be unusually large, composed of four segmental wires drawn into one—a new method, combining the advantages of a conductor formed of many strands, while obviating the drawbacks upon that mode of construction. This conductor is to be insulated with four coatings of gutta percha and Chatterton's compound, the whole insulating material to be wound round with broad tape or webbing, strongly bound on. Outside this again comes a "serving" of tarred hemp, and then the protecting sheath or iron covering of twelve large galvanized iron wires, to be wound on spirally. With ordinary cables the protecting covering would stop at the outer iron wires, but in this instance, as the line is to be laid in comparatively shallow water, the wires themselves, though galvanized, are to be still further protected from their most formidable enemy—rust. This is done most effectually by coating the whole cable thickly with two servings of tarred hemp yarn, overlaid with two coatings of a patent composition invented by Sir Charles Bright and Mr. Latimer Clark. The composition consists of mineral pitch or asphalte, Stockholm tar, and powdered silica, mixed in certain proportions and laid on hot. When quite cold this forms a massive covering of great strength and perfect flexibility, totally impervious to water, and incapable of being destroyed by the minute animalculæ

which exist in such abundance in tropical waters. The weight of these main sections of the cable is about three tons per mile, but the extreme shore ends will be very massive, coated with galvanized iron-wire of almost tenfold strength, and weighing as much as fifteen tons a mile. In certain portions of the route near Bussorah, where there is any danger to be apprehended from small coasters anchoring, the weight of the line will also be increased by the extra thickness of its wires to nine tons a mile—enough to shield it from any risk from anchors there. The contract for the manufacture of this cable has been given to Mr. Henley, of North Woolwich, who has undertaken to make it at the rate of not less than fifty nautical miles per week, and who, from the extent of his works, will probably be able to turn it out even faster. At every stage of its manufacture, the electrical staff of Messrs. Bright are to test it for insulation and conductivity, and the standard below which it is not to be allowed to fall in either of these respects is fixed at nearly 25 per cent. higher in proportion than almost any cable has ever yet attained. In short, as far as depends on minute care and a wide scientific experience, the whole cable is likely to be as perfect as skill or ingenuity can make it. The vessels which are to take this line will probably leave England about the end of next June, arriving on the scene of their operations in the Persian Gulf in November or December—the best time of the year in which to lay the cable. The process of submerging it and securing the shore ends is not likely to occupy at the most more than three weeks. The total cost of the submarine sections of the line will be less than 300,000*l.*, including the expenses of laying it.—*Times.*

THE ATLANTIC TELEGRAPH.

PERIODICALLY, and as if by necessity (says the *Mechanics' Magazine*), the great question of uniting Europe and America by Telegraph surges up and demands a practical solution; and it is quite natural that it should do so. No scientific industry of modern times has been more economically successful than the electric telegraph. There are now at work, in the United States of America, 40,000 miles of telegraph, extending from San Francisco, on the Pacific, to Newfoundland, on the verge of the Atlantic Ocean—where it is again proposed to land a cable which shall have its other end at Valentia Bay. There are upwards of 150,000 miles of working telegraph in Europe. A telegraph spanning the Atlantic would unite the electric wires of America with those in Europe, as those in Europe are now united with many in Asia and Africa. Establish a telegraphic link between Newfoundland and Ireland, and instantly means would be taken to connect our West Indian colonies and those of other countries with the mainlands of North and South America, thus bringing the whole industrial system of the two Americas into connexion with that of nearly all the rest of the world. We believe it is possible and practicable; and if the Governments of England and

the United States will render legitimate assistance, the great idea may soon be made a great fact. It may be said that an attempt was made a few years since, and the result is a useless and perishing cable at the bottom of the Atlantic. It would be folly to pass over this significant fact in silence. The failure of that cable should not, however, be a rock to discourage, but rather a beacon to guide in the pathway of future efforts. It is almost certain that the Atlantic cable failed from controllable causes. It was manufactured and laid with undue haste. Conditions, moral and scientific, which should have been complied with were trifled with or neglected. In a second attempt, more care must and will be taken. As far as the science of submarine telegraphy has yet developed itself, the greatest electrical difficulty is experienced in getting signals through very long lines of submerged wire, owing to the retardation of the current. The difficulty of working through long circuits owing to the retarding effects of inductive electricity increases in about the square of the length of the line when long insulated wires are laid either in the earth or under water. This is not the case with land lines carried through the air, as the natural humidity of the atmosphere and the loss of electricity over the many points of support prevent any strong manifestation of inductive influence; but a long line of wire, perfectly insulated throughout its length, becomes, in fact, a Leyden jar, and in proportion to its length, so is the difficulty of discharging it to produce distinct signals at the further end increased. Thus it is that if two lines of the same dimensions and cost as regards copper and insulation were laid, one for 500 miles and the other for 1500, the former could be worked through for messages at nearly nine times the speed of the latter. Hence a line laid in sections must always possess immense advantages over long unbroken circuits. Science may, of course, yet discover the means of working through a cable of 2000 or even 3000 miles as easily as lengths of 200 or 300 miles are now worked through; but at present all experience is against the attainment of such a happy result.

Two companies are striving to effect this grand object, but in each case important difficulties remain to be surmounted.

This question of an Atlantic telegraph is not merely economically and morally interesting to England and the United States, but it involves world-wide results. It would not only be the greatest triumph of science, but it would be the means of bestowing a rich inheritance of blessings on mankind. It is a benefit which the statesman, the capitalist, the economical reformer, the philanthropist, and philosopher may heartily join hand in hand to promote.

Chemical Science.

ALLOTROPIC STATES OF OXYGEN.—NITRIFICATION.

AFTER many fruitless attempts, Professor Schönbein has succeeded in isolating ozone from an ozonide, and in finding out simple tests for distinguishing ozone from its antipode, antozone. He has also produced ozone by dissolving pure manganate of potash in pure oil of vitriol, and introducing into the green solution pure peroxide of barium, when ozone mixed with common Oxygen will make its appearance, as readily perceived by the nose. By this ozone Professor Schönbein rapidly oxidized silver at the temperature of 20 deg. Cent., and "by inhaling it produced a capital catarrh." Regarding Nitrification, he states that he has generated "nitrite of ammonia out of water and nitrogen—viz., atmospheric air—a most wonderful and unexpected thing. Let," says he, "a piece of clean linen, drenched with distilled water, dry in the open air; moisten it then with pure water, and you will find that the liquid wrung out of the linen, and acidulated with sulphuric acid (chemically pure), will strike a blue colour with starch paste containing iodide of potassium—the most delicate test for nitrites. It is, therefore, a fact that shirts, &c., in fact, all linen, must contain appreciable quantities of nitrite of ammonia." After giving several forms of the experiment, he refers to results obtained by him eighteen months previous—viz., that during the slow combustion of phosphorus in moist atmospheric air very perceptible quantities of nitrite of ammonia were formed. Now, he has hardly any doubt that the production of that nitrite is due to the evaporation of water about the phosphorus, whose temperature, in consequence of its burning state, is higher than that of the surrounding medium. The same remark applies to the formation of nitrite of ammonia during the rapid combustion of charcoal in moist air. [Our readers will recollect that our atmosphere is a mixture, and not a compound, of oxygen and nitrogen; that these two gases will remain distinct for ages, but that when made to combine by chemical means, as in nitrous oxide and nitric acid, they manifest strong chemical affinities.] Professor Schönbein concludes by saying, "that as evaporation is continually going on in our atmosphere, and along with it the generation of nitrite of ammonia, hence nitrates and other salts are readily formed, and in our rainy climates are speedily washed away into our springs, rivers, &c. The formation of nitrite out of water is also a highly important fact for vegetation. In fact, each plant thus becomes a generator of nitrite of ammonia, preparing at least a part of its nitrogenous food; and the same thing takes place on the ground on which it stands." Hence Liebig may be right in saying that no plant requires an artificial supply of ammonia. Professor Faraday, in a note to the foregoing communication, says that, "in relation

to the peculiar circumstances under which oxygen and nitrogen combine, it may be worth while to refer to the results obtained by Dr. Bence Jones (*Phil. Trans.*, 1851), where the direct union of these gases in all cases of combustion in air is described. Schönbein's results depend on evaporation."—*Illustrated London News.*

PREPARATION OF OXYGEN.

Mr. Matthey, we are informed, is able to decompose at one time about fifty pounds of chlorate of potash mixed with the same weight of manganese. He has thus proved that although the disengagement of gas be prodigiously rapid, yet, if the abductory tubes be sufficiently large, there is really no danger of explosion, and no sensible increase of pressure on the apparatus.—*Ibid.*

CARBONIC ACID AS AN ANÆSTHETIC.

Carbonic Acid has been employed as an Anæsthetic by M. Ozanam in a surgical operation. He mixed three parts of the gas with one part of atmospheric air in a large india-rubber bag, provided with a flexible tube, and a mouthpiece by which the patient inhaled the mixture. Sleep was produced in about two minutes: it was accompanied by acceleration of the respiratory movements and copious perspiration on the face. The moment the inhalation was stopped, the patient awoke with perfect consciousness.

CHLOROFORM.

The action of Chloroform is treated of as follows by Dr. Phipson, in the *Popular Science Review*:—

"Under the influence of chloroform the nervous centres lose their powers in regular succession. This is not only an interesting physiological fact but also a practical point of great importance. First, the cerebral lobes lose their influence, and consciousness disappears entirely. Next, the cerebellum loses its power of regulating locomotion; then the spinal cord becomes incapable of producing sensation and of originating motion; but the medulla oblongata (that portion of the spinal cord which enters the brain), which presides over respiration, still retains its functions. Next, the medulla oblongata is affected; when this occurs breathing ceases and death is near; but even yet the ganglionic nerves of the sympathetic system perform their functions, and the heart and intestines continue to move for a time, often with vigour. In the human body exist different systems of nerves, and the art of producing anæsthesia consists in allowing one system to work as usual while the other systems are under the influence of sleep. The nerves of motion and of sensibility are made to sleep, whilst the nerves of organic life continue their functions. We are now enabled to appreciate these wonderful discoveries and to admire the marvellous arrangement of the nervous system. The problem of depriving man of sensibility and motion, without impeding respiration, circulation, digestion, or, in other terms, of depriving him of his faculty of moving and of feeling pain without depriving him of life, has been solved. During anæsthesia (the sleep of chloroform) man lives like a plant; his animal faculties are taken from him for a time."

WATER-GAS.

Illuminating Gas has been frequently produced from water and liquid hydro-carbons, especially by the process of MM. Bal-

damus and Grune, which is based on the decomposition of the water at a red heat by the hydro-carbons. In this condition the hydrogen of the water combines with the carbon of the hydro-carbons, in order to form a hydro-carbon more hydrogenized, and possessing a very high illuminating power. The reaction takes place in the following manner:—At this high temperature the liquid hydro-carbon is transformed into ordinary illuminating gas by abandoning part of its carbon, which decomposes the water by forming carbonic oxide, with small quantities of carbonic acid and proto-carburetted hydrogen. This gas, as well as the carbonic oxide, becomes saturated with the liquid hydro-carbon, and forms a brilliant illuminating gas. Hitherto, it is said, we have not attained to a practical solution of this problem, because the decomposition of the water and the hydro-carbons did not take place at the same time. MM. Schäffer and Walker state that by decomposing the whole in the same apparatus at the same time, they have obtained results in full accordance with the theory. With this view they arrange that a retort, heated to redness and filled with coke, shall receive at the same time the vapour and the liquid hydro-carbon. They thereby obtain a gaseous mixture possessed of an illuminating power three times that of the gas obtained from coal. They state that they can vary this illuminating power at will by admitting into the retort more or less of the vapour of water.—*Illustrated London News.*

THE LIME LIGHT.

WE have been favoured by Mr. James McHaffie, of Bombala, New South Wales, with the following communication, "saved from the wreck of the *Colombo.*"

"In the *Year-Book of Facts*, 1862, page 107, you record the discovery by Mr. T. W. Tobin, that a diaphragm of carbon may be arranged in a tube so as to dispense with part of the apparatus at present used in the production of the Lime Light. Some twenty years ago, when experimenting with the blowpipe, I discovered a similar means of obviating the necessity for the two gasometers, and the complicated stop-cock then used in producing the oxy-hydrogen flame; and seven years ago I published the plan in the *Melbourne Argus* newspaper.

"Oxygen and hydrogen may be mixed in one gasometer, and burned with perfect safety by adopting the following arrangement:—Let the pipe communicating with the gasometer terminate in a metal tube, at least four inches long, with a jet attached. Stuff the tube close to the jet with fine wire, such as is used in the manufacture of wire-gauze for sifting flour. The diaphragm of wire thus formed, by absorbing the heat of the flame, prevents combustion extending to the gasometer, on the same principle that the gauze of the Davy lamp prevents the flame inside the gauze from being communicated to the gases outside the gauze. The larger the diameter of the stuffed tube, the greater the volume of

gas which will pass through; while the greater the length of the stuffed tube, the greater the security against the bursting of the gasometer. No space should exist between the jet and diaphragm, for fear of an explosion at that point. A bladder filled with the mixed gases is a safe gasometer to test the value of my suggestion."

OZONE EXHALED BY PLANTS.

In an elaborate memoir presented to the Academy of Sciences, at Paris, M. Kosmann gives an account of a series of experiments in regard to this subject, carried on at his own house in the middle of Strasburg, in the Botanic Garden of that city, and in a spacious garden above thirty miles from it: these three places seeming to offer the differences which should characterize vegetation in the midst of towns and that of the country in various degrees. He made use of Schönbein's ozonometric scale and ozonoscopic bands, fixed on the plants. For details we must refer to the *Comptes Rendus*, Nov. 10 last. He gives the following as the results of his observations from July 29 to Sept. 14 last. (He proposes to resume his studies in the spring.)—1. Plants give off ozonized oxygen from the midst of their leaves and green parts. 2. Their leaves give off during the day ozonized oxygen in ponderable quantity, much greater than that which exists in the surrounding air. 3. During the night this difference disappears where vegetables are sown sparingly; but where there is an accumulation of plants, and they grow vigorously, even in the night the ozone observed in the plants is greater than in the air, which is, doubtless, explained by supposing that the ozone disengaged during the day continues to surround the plants during the night when the weather is calm. 4. Plants in the country give off more ozone than those in the town during the day—probably due to vegetative life being more active—the former also reducing more carbonic acid. 5. Hence we may infer that the air of the country and that of habitations surrounded by vast gardens, forests, &c., is more vivifying than that of towns. 6. In the midst of towns and a concentrated population, the ozone of the air at night is more considerable than the ozone of the air by day. If we go away a little from this concentration of men, and enter into that of plants, the excess of the ozone of the night above that of the day diminishes; and if we advance further into the country, where plants are more numerous than men, the ozone of the day becomes more considerable than that of the night. 7. The interior of the corollas gives off no ozonized oxygen. 8. In dwelling-rooms oxygen does not generally exist in the ozonized state."—*Illustrated London News.*

ABSORBING POWER OF THE HUMAN SKIN.

Dr. Murray Thomson observes:—For the last sixty years physiological and other authors have been maintaining two very

opposite views in regard to the absorption by the skin of substances dissolved in the water of baths. Some authors holding that such salts as iodide of potassium readily reach the blood through the skin, when applied in the form of a bath containing that salt; while others hold that absorption, under such circumstances, never takes place.

My experiments were all made on my own person at various intervals during the last two years. Six of them were made on as many successive nights, so as to try if frequency of bathing rendered the skin more permeable. The general method of making the trials was this:—Into an ordinary bath, a measured quantity of warm water was let, the temperature of which was recorded. Means were taken to keep the heat constant during the experiment. The temperatures ranged usually from 90° to 98°. The salt to be tried was then dissolved, and mixed with the water. The time in the bath was noted; it varied from half an hour to one hour and a quarter. The whole body was immersed, excepting the head and neck. All the urine voided in twenty-four hours after each bath was collected and concentrated, then tested for the substances experimented on. Six baths were taken, in which iodide of potassium was dissolved. The quantity of the salt varied from 200 to 1300 grains. Five baths, in which quantities of ferrocyanide of potassium, varying from 1400 to 5000 grains, were dissolved. Four baths were taken, the water of which was rendered strongly alkaline by soda. The result of these fifteen experiments was, that I could not find that any of the substances in the baths passed through the skin into the blood, so as to be found in the urine; the soda baths did not render it alkaline, nor could I detect the other salts in it; and it is to be noted that the tests for them were extremely delicate.

The general conclusion which my experiments lead me to are, 1. That though not denying that absorption by the skin of aqueous solution does take place, yet it seems to be the exception and not the rule. 2. That medicated warm baths, whether natural or artificial, do not appear to owe any virtue they may have to the substances dissolved in them reaching the blood through the skin. At the same time, as there are other ways by which one can conceive such baths to operate on the system, it is not to be concluded that, because absorption may not take place, such baths are useless as therapeutic agents.—*Proc. Royal Soc. Edinburgh.*

IODIDE OF LITHIUM.

LIEBIG has described the following simple method of preparing Iodide of Lithium and certain other iodides:—

One part of amorphous phosphorus is placed in a mortar with forty times its weight of warm water; twenty parts of iodine are added, and brought well in contact with the phosphorus by rubbing. The liquid, at first dark brown, afterwards becomes colourless, and more rapidly if heated in the water-bath. The liquid is poured off from the small residue of phosphorus and quite saturated with baryta, at first with carbonate, and afterwards with baryta-water;

and then filtered from the phosphate and well washed out. The clear filtrate now contains iodide of barium; and by double decomposition with carbonate of lithia iodide of lithium is formed. The acid liquid formed by the action of iodine on phosphorus and water, which consists of phosphoric and hydrodic acids, may be neutralized with lime instead of baryta; the method is otherwise the same. In the place of amorphous phosphorus, ordinary phosphorus may be used; the action is then quicker, but also more violent.

Pettenkoffer, under Liebig's direction, made experiments in order to see if iodide of potassium could not be advantageously prepared by the above method: one ounce of phosphorus was treated with iodine in the manner described, as long as the iodine dissolved without colouring the liquid; for this 13½ ounces of iodine were necessary. The clear liquid was poured off from a small quantity of amorphous phosphorus which had been formed, and milk of lime, prepared from 8 ounces of burnt lime, added until the liquor was alkaline. After filtration, a hot solution of 9 ounces of crystallized sulphate of potash in 48 ounces of water was added, and the whole allowed to stand six hours. After filtration from the sulphate of lime, the clear liquid was evaporated down to a quart, and a solution of pure carbonate of potash added as long as a precipitate of carbonate of lime was formed. This was filtered; and the clear liquid, when evaporated to crystallization, furnished a crop of 13 ounces. The mother-liquid, evaporated to dryness, gave 3½ ounces more of perfectly pure pulverulent iodide of potassium. The theoretical quantity required is 17½ ounces.—*Philosophical Magazine.*

PHLORYDZINE.

PHLORYDZINE is a neutral principle which exists in considerable quantities in the bark of the root of the apple, plum, and cherry-tree—also, probably, in some others—but principally in the root of the apple-tree, from which source we are mainly supplied. Phlorydzine, as at present in the market, is in the form of powder of a dirty white colour, consisting of broken-up silky needles, in appearance not unlike quinine which has not been well bleached. When rubbed between the fingers it has a soft velvety feel very like that of French chalk; but if the substance be crystallized by the slow cooling of a dilute solution, previously treated with freshly-prepared animal charcoal, it will then be obtained perfectly white, and in the form of long, flat, brilliant, silky needles. Its taste is peculiar, it is very bitter at first, but ends by leaving a somewhat sweetish taste with a flavour of apples on the tongue. This substance contains no nitrogen, and thus differs from quinine. In an article on the subject in the *Dublin Quarterly Journal of Medicine*, Dr. de Ricci thus recapitulates the advantages of phlorydzine:—"It may be used where neither quinine, salicine, nor bark can be administered, with impunity; it is perfectly adapted to young children; it is not expensive; and we are not depending for its supply on the rapidly-diminishing Cinchona forests of South America, but have abundant supplies of it at home."

ANTOZONE.

PROF. HUXLEY has read to the British Association a paper on Schönbein's "Antozone." The author said he had received a specimen of a mineral containing a peculiar substance from Professor Liebig, with a request that he would bring it under the notice of the members of the British Association. The mineral, a fluor-spath, when rubbed gives off a strong odour closely resembling the smell of bleaching powder, and when pounded under distilled water in a mortar the water instantly acquires very peculiar properties, several of which Dr. Harley mentioned. The following one he illustrated by experiment — namely, the turning a colourless solution of iodized starch to an intense azure blue. Lastly, Professor Harley said that it was possible, as Schönbein supposed, that the so-easily decomposable substances existing in the mineral in a free state had been there during centuries,—probably even from the time of its first formation. Moreover, as the mineral loses all its peculiar properties when heated, it was evident that since the mineral acquired these the earth around it and the district where it is found can never have been subjected to a high temperature.

ANALYSIS OF POMPEIAN GLASS.

THE Glass of Pompeii has been examined by M. G. Bontemps, who has reported on the subject to the French Academy of Sciences. The certainty that glass had been employed by the ancients anterior to the year A.D. 79, the date of the eruptions of Vesuvius which buried the cities of Herculaneum and Pompeii, has caused manufacturers to desire information as to the mode of making this glass—whether it was blown or cast, &c. Through the kindness of the French and Italian Governments, Mr. Bontemps has obtained specimens of glass from Pompeii. The fragments received measure no less than 10 centimètres. The glass is well cast, free from knots and other defects. Some pieces are exempt from bubbles, others contain them in large quantities, but they are not all inherent to the fusion. The thickness of the glass is unequal; in some places it is more than 5 millimètres, in others only 3 millimètres. The glass shows evident marks of having been rolled. The colour is a bluish-green, similar to that of the common glass made about fifty years ago. The following are the compositions of the glass of Pompeii, analysed by M. F. Claudet, and of that of the present day, analysed by M. Dumas :—

Glass of Pompeii.		Good Modern Glass.	
Silica	69·43	Silica	72·50
Lime	7·24	Lime	13·10
Soda	17·31	Soda	13·00
Alumina	3·55	Alumina	1·00
Oxide of iron	1·15	Oxides of iron and manganese	0·40
Oxide of manganese	0·39		
Oxide of copper	traces		
	99·07		100·00

AMERICAN DIAMOND.

THE largest diamond in North America is now being exhibited at Boston. It was found about a year since in the northern part of North Carolina, on the Virginia border, near the Blue Ridge. In the rough it weighed nearly 24 carats, and the cut diamond weighs nearly 12 carats. Its value is between $10,000 and $13,000, and but for two almost inappreciable spots it would be worth more. In size it approaches a large plum-stone in length, but it is deeper and broader, almost a square on the face, with rounded corners. Each of the numerous facets had to be ground down separately, it being unsafe to chip off corners for fear of cracking the stone. The cost of the fine sand used for this purpose was above $100, and the charge for the entire work $1500.

ALUMINIUM.

MR. R. JACKSON, of Pimlico, in a communication to the *Times*, says :—It is stated in one of the most recent works on Chemistry (*Miller's Elements*) that the metals of the earths, to which class Aluminium belongs, "cannot be obtained from their oxides by the action of carbon." It is proved, by the following experiment, that carbon *is* capable of removing the oxygen from alumina.

Dissolved pure alumina in solution of tartaric acid, and to the tartrate of alumina added about twice its weight of sugar, evaporated to dryness and calcined in an evaporating dish ; the carbonaceous mass was then mixed with an equal weight of dried common salt, the mixture placed in a Cornish crucible, and covered to the depth of nearly two inches with finely-powdered charcoal, and submitted to a bright red heat for about one hour. On inverting the crucible, after cooling, the alumina mixture came away as a coherent mass, retaining the form of the inner surface of the crucible, but thickly covered with globules of the reduced metal. A few of these I removed, and returned the mass to the crucible, for the purpose of obtaining a button of the metal by another fusion.

In this, however, the experimenter was disappointed, as by the too sudden application of heat the crucible cracked, and the aluminium disappeared.

Several attempts since made to obtain the metal have been unsuccessful, although the conditions of each experiment have been, as near as I could judge, those under which I had succeeded in my first trial.

ELECTRO-CHEMICAL REDUCTION OF THE METALS.

A MEMOIR on this subject, by M. Becquerel, has been read to the French Academy of Sciences, and specimens of the metals obtained presented. "When," says M. Becquerel, "we decompose concentrated solutions, whatever may be the composition, with currents the intensity of which is very feeble and depends on the density of

the solution, we avoid tumultuous deposits, and the molecules group themselves regularly, and aggregate with adherence." Acting on this principle, he has been enabled to obtain a great number of mineral substances by electro-chemical decomposition. In the present memoir he describes the means adopted to procure fine specimens of cobalt, nickel, gold, silver, and platinum.—*Illustrated London News.*

CAST-STEEL.

THE production of Steel in France (from substances hitherto considered unfit for the purpose) is the subject of a paper laid before the French Academy of Sciences, by the eminent chemist, M. E. Frémy. While in England, as a juror of the International Exhibition, he visited manufactories and obtained information on the processes employed in steel manufacture, especially that of Mr. Bessemer. On leaving England he bore with him the conviction that Mr. Bessemer's apparatus could produce a metal fit for foreign castings, but feared that the French castings with coke contained too much sulphur and phosphorus to be usefully employed in the new method. However, he found all his fears disappear on experimenting at St. Seurin in the steel manufactory of Mr. W. Jackson. We have no space for the details given of these experiments, which will be found in the *Comptes Rendus*, Vol. lv., No. 7. M. Frémy sums up his paper by expressing his conviction that, by the new processes employed, cast-steel may be obtained of all the qualities required in manufacturing industry and for warlike and nautical purposes—a pure homogeneous steel, easily produced with the expenditure of very little fuel. "It will," he says, "effect a revolution in metallurgy of great advantage to France, since iron may be replaced, in many of its applications, by steel produced in a most economical manner." Considerable masses of the cast-steel alluded to were shown at the office of the Institute when M. Frémy's paper was read, and were considered as true and honourable monuments of a conquest obtained in metallurgical science.—*Ibid.*

LUMINOSITY OF PHOSPHORUS.

DR. MOFFAT has read to the British Association a paper "On the Luminosity of Phosphorus." If a piece of phosphorus be put under a bell-glass and observed from time to time, it will be found at times luminous, and at others non-luminous. When it is luminous a stream of vapour rises from it, which sometimes terminates in an inverted cone of rings similar to those given off by phosphoretted hydrogen; and at others it forms a beautiful curve, with a descending tint equal in length to the ascending one. The vapour is attracted by a magnet; it is also attracted by heat, but it is repelled by cold. It renders steel needles magnetic, and it is perceived only when the phosphorus is luminous. Results de-

duced from daily observations of the phosphorus in connexion with the readings of the barometer, the temperature and degree of humidity of the air, with directions of the wind, for a period of eighteen months, show that periods of luminosity, or phosphorus and non-luminosity, occur under opposite conditions of the atmosphere; the former being peculiar to the equatorial, while the latter is peculiar to the polar current. By the catalytic action of phosphorus on atmospheric air, a gaseous body (superoxide of hydrogen) is formed, which is analogous to, if not the same, as atmospheric ozone, and it can be detected by the same tests. The author has found, by his usual tests, that *phosphoric* ozone is developed only when the phosphorus is luminous.

Periods of luminosity and periods of atmospheric ozone take place under similar atmospheric conditions, and the conditions of non-luminous periods and periods of non-atmospheric ozone are the same. From the author's observations in connexion with this matter, which extend over several years, it appears that 99 per cent. of luminous periods, and 91 per cent. of ozone periods commence with decreasing readings of the barometer and other conditions of the equatorial current, and that 94 per cent. and 66 per cent. terminate with increasing readings and the conditions of the polar current. Luminous periods commence and luminosity increases in brilliancy on the approach of storms and gales, and ozone periods commence and it increases in quantity under similar conditions. There is, it would appear also from these observations, an intimate connexion between the approach of storms, the commencement of luminous and ozone periods and disorders of the nervous, muscular, and vascular systems. Here the author gave the dates of many storms and gales, and the occurrence of diseases of the above class, showing their coincidence; and in corroboration of what he had stated, he mentioned the fact that there was a concurrence in the issuing of Admiral FitzRoy's cautionary telegrams and these diseases. He also stated that he views the part performed by ozone in the atmosphere as being similar to that performed by protein in the blood; the latter giving oxygen for the disorganization of worn-out tissues in the animal economy,—the former giving oxygen to the products of decomposition and putrefaction, and rendering them innocuous or salutary compounds. With these views he has used phosphorus as a disinfectant; and from the results he has obtained, he believes that by using ozone artificially formed by the action of phosphorus in localities tainted with the products of putrefaction, just in sufficient quantity to tinge the usual test-paper, all diseases of the pythogenic class would be prevented.

Although the data are too few to theorize upon, Dr. Moffat hoped that he would be excused for pushing the matter beyond a simple statement of facts and observations, as many facts had been observed in nature which strongly corroborated all he had advanced. Ozone, he observed, is in all probability formed wherever there is phosphorescence; and this is by no means an uncommon phenome-

non. It is seen in life and in death, in the animal and vegetable kingdoms, and in the mineral kingdom. Here many instances of phosphorescent bodies were enumerated, among which the night-shining Neries was named as becoming particularly brilliant with a direction of wind from points of the compass between east and south; and the fact that the sea becomes luminous on the approach of storms by marine animals floating on its surface was noticed. Many phosphorescent minerals were named; the fluorspar being particularly pointed out as being not only phosphorescent on slight increase of temperature, but as giving off ozone. The author concluded by observing that it is not improbable that atmospheric ozone is formed by the phosphorescence of these and similar bodies, and pointed to the absence of ozone and weak magnetic action during cholera periods, which are periods of non-luminosity, and to the disappearance of cholera with the setting in of the equatorial current, which is ozoniferous and favourable to luminosity. The aurora, the author thinks, may yet be proved to be a display of luminosity.—*Athenæum.*

PHOSPHORESCENCE OF PORK.

THE bodies of marine fish and of some other animals frequently become phosphorescent before putrefaction begins. To do so, the presence of humidity, oxygen, and a certain temperature is required. M. Hankel, in the *Annalen der Physik*, gives an account of this phenomenon appearing on Pork. The Phosphorescence was silvery white, and enlightened the neighbouring objects. It was superficial, for on cutting the flesh with a knife, the under part was obscured till after a certain time, when doubtless the oxygen of the air had had time to act. The phosphorescent matter was of an unctuous character, and M. Hankel could not perceive in it any traces of organized beings. The light was annihilated by the application of ether, alcohol, a solution of caustic potash, cold, hot water, and a temperature of 104 Fahr., but in the last two cases, the light reappeared when the flesh was restored to the ordinary temperature. The light also disappeared when placed in a vacuum or in an atmosphere of carbonic acid, but returned when a little oxygen was permitted to enter. Sulphuric acid annihilated it for ever. Ozonized oxygen does not sensibly affect this phosphorescence. Fatty oils lessen its duration (this is the case also with distilled water), but none of these liquids become phosphorescent by contact with this animal matter.

MANUFACTURES FROM PEAT.

DR. B. H. PAUL has read to the British Association a paper "On the Manufacture of Hydro-carbon Oils, Paraffin, &c., from Peat." The author described the results that had been obtained at some works lately erected under his direction in the island of Lewis, N.B. The peat of that locality was described as a pecu-

liarly rich bitumous variety of mountain peat, yielding from five to ten gallons of refined oils and paraffin from the ton. The results obtained at these works were contrasted with those obtained at the works of the Irish Peat Company some years ago, where the produce of oil was not more than two gallons from the ton of peat. This difference in the produce was ascribed, in a great degree, to the improper mode of working adopted at the Irish works. One of the most important points dwelt upon, was the necessity of regarding the hydro-carbon oils and paraffin as the only products that would afford a profit in working peat; and the failure of the Irish works was attributed to the attempt to obtain other products which could only be regarded as waste, and not worth working, unless the oils and paraffin were obtainable in a remunerative amount from the peat. Dr. Paul concluded his paper by expressing his opinion that, though the working of peat was surrounded by many serious difficulties as regards its establishment and prosecution, there was every reason to believe that such peat as that occurring in the Highlands of Scotland could be advantageously worked; and that if the manufacture of oils were undertaken with earnestness and perseverance, it would become a means of greatly improving the condition of those parts of the country, and a fertile source of profit.

OILS AND RESINS FROM VICTORIA.

A PAPER has been read to the British Association "On the Essential Oils and Resins from the Indigenous Vegetation of Victoria," by Mr. J. W. Osborne. Mr. Osborne drew the attention of the Section to the abundance of essential oils of indigenous growth in the colony of Victoria. The vegetation yielding them was to be found everywhere, forming in many instances large forests of miles in extent. Mr. Osborne stated that the yield was in most cases exceedingly large: for instance, the *Eucalyptus amygadalina*, a very large forest tree, bore leaves which, with the twigs to which they were attached, gave, in the green state, as much as three pints of the oil from 100 lb. of the fresh material. Thirty-five specimens of oils were exhibited, all of which were possessed of valuable properties; some were of medicinal value, others as perfumes, and the great majority would be serviceable in the arts as solvents for resins used in the manufacture of varnishes, and also for illuminating purposes, for which they were well adapted, as they burnt with a very white and clear light in lamps adapted for the consumption of paraffin oil, and were safe, inasmuch as they were ignited with great difficulty. The trees yielding these valuable products covered an area of the colony equal to 12,000,000 acres. Mr. Osborne next referred to the resins of the colony from the gum-trees or genus Eucalyptus, the *Callitris verrucosa*, and *cupressiformis*, from the *Xanthorrhœa australis* and the various species of the acacia, and described some of their properties and the purposes for which they were adapted.

PARAFFIN, OR COAL OILS.

ALTHOUGH some information as to these fluids has been given in a previous Section, we quote here the substance of an able article upon the same subject, in the *Mining Journal*.

Paraffin, and, indeed, all the varieties of the oils which are sold under this name, are, like it, compounds of carbon and hydrogen. They are produced by the distillation, at carefully regulated temperatures, of coal, of certain carbonaceous shales, and the different varieties of petroleum which are now so largely obtained in America and in Asia. According to the temperature at which the distillation is effected, there result heavy or light oils, as they are termed by the manufacturers. These oils are of variable specific gravities, and their boiling-points range all the way from 46 deg. to 600 deg. Fahr. Hence it is that explosions have arisen from the improper admixture of the lighter oils with the heavier ones. In some cases this has arisen from insufficient purification of the oil for burning, and in others (which include by far the larger number of cases) by the mixture of volatile oils obtained from other sources with the less inflammable oils distilled from coal. In the early stages of this manufacture Cannel coal was almost exclusively used as the oil-yielding material, but since the discovery of the oil wells of Pennsylvania and other places, petroleum has in a great measure supplanted the use of coal, some establishments using the natural oil alone. The object of this is readily appreciated. The petroleum being naturally in a liquid state, there is no necessity for a preliminary distillation, as in the case when coal is used, in which event the crude oil must be first produced by exposing the coal to distillation at a low heat, and the resulting product be treated in the same manner as the oil already formed in the wells. By the use of petroleum the retorts for the first distillation are dispensed with, and thus a saving is effected in apparatus as well as in time and labour. When petroleum alone is used in the manufacture of kerosene oil, the product contains a much larger proportion of volatile hydrocarbons than when coal is wholly or partially employed, and, therefore, more precautions are necessary, and greater labour is requisite, to effectually get rid of these dangerous substances. Some manufacturers not only neglect to remove these volatile compounds from the oils, but actually purchase the light oils from more conscientious refiners, in order to mix them with heavy oils to make them burn. This is an exceedingly reprehensible practice, and deserving severe punishment, for the heat generated by the heavy oils in burning vaporizes the volatile portion, and renders it liable at any time to explode.

The oils distilled wholly from coal, or those with which but a small proportion of petroleum has been mingled, are much more easily freed from dangerous portions. By careful refining, and after-distillation, steaming, and a large surface of atmospheric exposure, every dangerous compound can be removed, and no fear need be apprehended from oils which are known to be subjected

o a rigid and conscientious refining. In purchasing oils, however, nothing should be taken for granted. They should be carefully tested, and their liability to explode fully investigated. The simplest and most satisfactory test of safety is to place the oil in an open dish in a water bath, and heat it up from 130 deg. to 140 deg. Fahr. If, when elevated to this temperature, on applying a match it does not ignite, it may be pronounced very safe. If it ignites but slowly or sluggishly it is safe. But any oil that lights quickly in an open dish, at a temperature of below 130 deg. Fahr. may be considered as dangerous.

A metallic fountain or reservoir should always be avoided in using any of these hydrocarbon oils. To show the vast difference of the oils now on sale as paraffin oils in this country, Dr. R. Angus Smith, F.R.S., of Manchester, an eminent chemist, has lately found that oil made by Mr. Young, the inventor, and his partners, from coal, and who have really the only right to call their oil paraffin, will not ignite in an open vessel at 154 deg. Fahr.; while a sample of American rock oil, sold as paraffin, exploded at a temperature of 46 deg. Fahr.

Dr. Lyon Playfair, in one of his recent lectures on the Chemical Arts, gave an account of the production of paraffin oil and wax from coal, especially from Boghead coal, concerning the nature of which there has been so much litigation. This paraffin, it was stated, is merely the solid and liquid form of the hydro-carbon "olefiant gas," which is obtained from the distillation of coal and peat. In 1841 Liebig condensed this gas into wax and oil; and at the Exhibition of 1851 only one paraffin candle was exhibited. In the recent exhibition there were large blocks of paraffin, and numerous specimens of candles, the manufacture having become of very great extent.

RAVAGES ON CREOSOTED TIMBER.

It would be difficult to estimate the value of any chemical or mechanical process whereby Timber might be rendered permanently impervious to the Ravages of the *Linnoria terebrans*, that small but sure destroyer of the timber structures exposed to the action of the sea.

The justly-approved creosote process, patented by Mr. Bethell, has been largely employed in railway works, with universally admitted success, and, in common with many of his professional brethren, Mr. David Stevenson adopted it in several marine works, in the expectation that it would prove an antidote to the Linnoria; but Mr. Stevenson has now ascertained beyond all doubt that creosote is not a universal or permanent preservative of timber used in such works.—*Proc. Royal Soc. Edinburgh.*

MANURES ON GRASS LANDS.

Mr. J. B. Lawes and Mr. J. H. Gilbert have communicated

to the British Association a paper "On the Effects of Different Manures on the Mixed Herbage of Grass Land." At the Aberdeen meeting the authors had shown the great difference in both the chemical and botanical characters of the herbage induced by different kinds of manure, each applied for three consecutive years on the same plot in a portion of Mr. Lawes's park, which had been meadow for probably some centuries. Now, after the continuance of the experiment for four more years, they gave the results of a more complete botanical analysis of the produce.

The details were exhibited in tables; the general results may be stated as follows:—Unmanured, the land gave 38 species of plants, contributing in a more or less degree to the mown produce, of which about 75 per cent. was graminaceous, 6 per cent. leguminous, and 19 per cent. miscellaneous. Mineral manures, on the other hand, gave 37 species, and the produce contained only 68 per cent. of graminaceous and 9 per cent. of miscellaneous, but 23 per cent. of leguminous herbage. Ammonia salts gave 32 species; 89 per cent. of the produce being graminaceous, nearly 11 per cent. miscellaneous, and only 0·5 per cent. leguminous. When the mineral manures and ammonia salts were employed together, in quantities sufficient to yield large crops, only from 20 to 26 species could be detected, and from 90 to 95 per cent. of the total produce was graminaceous, there being scarcely a vestige of leguminous herbage then to be found. The influence of ordinary farm-yard manure, of nitrates, and other manuring substances, was also indicated. It happened that large crops could only be obtained when large amounts of nitrogenous as well as mineral constituents were employed; and, under these circumstances, the produce would be in very large proportion graminaceous, while leguminous herbage almost entirely disappeared, as also did numerous miscellaneous plants, though some few, as plantago, rumex, ranunculus, milfoil, and carum, were one or more increased in quantity according to the description of the manure. In the experiments in question, the largest crops were not only almost wholly graminaceous, but the great proportion consisted of but few genera, the principal being dactylis, poa, holcus, lolium, and agrostis. In fact, it seemed impossible to have at once large crops and great complexity of herbage. This was a point of considerable interest just now in connexion with the question of the application of town sewage to grass land. In some experiments on the application of sewage at Rugby, it was found that the herbage became more simple, the bulk of the produce consisting of dactyls, lolium, and holcus, with scarcely any leguminous herbage, but a good deal of ranunculus, and more or less of some other weeds and other grasses than the three named. On a large proportion of the sewage meadows at Edinburgh again, the produce was composed almost exclusively of three or four species, of which triticum repens and lolium perenne were the most predominant.

DISEASED TREES.

M. PAYEN recommends the following cure for Diseased Trees and Shrubs :—As soon as it is perceived that the leaves are turning yellow the earth must be dug up all round the root within the space of a mètre and a half from the stem, and the roots are then watered, twice on the first, and once on the following day, with a solution of 525 grammes of sulphate of iron, 500 of common salt, and 525 of alum in 40 litres of water. This treatment will instil fresh vigour into the sound roots, corrode the bad ones, and restore the health to those which were about to be attacked. The amalgam of sodium as an agent for reducing metals is beginning to attract attention.

DECAY AND PRESERVATION OF STONE.

DR. B. H. PAUL, in a paper read to the British Association, describes the causes and nature of the Decay of Building-stone as being both chemical and mechanical, and varying according to the nature of the stone and the conditions to which it was exposed. The various methods which have been proposed for the preservation of stone from decay were described in detail; the author considering from a chemical point of view, that none of them presented any probability of success in effecting the desired result; and that the discovery of an efficient and practicable means of preventing the decay of stone, especially in towns, still remains to be made.

CHEMICAL ARTS AND PUBLIC HEALTH.

DR. LYON PLAYFAIR'S concluding lecture at the Royal Institution, "On the Progress of the Chemical Arts since 1851," strikingly illustrated the relation of these arts to the public health. Dr. Playfair first reminded his audience that the organic world is built up of the four elements, carbon, oxygen, hydrogen, and nitrogen; and that the continual transformation going on in organisms tends to simplify their arrangements, bringing them back to the forms of carbonic acid (CO), ammonia (HN), and water (HO). These transformations are similar to the forms of ferment which occur in malting, brewing, and vinegar-making, of which illustrations were given. The putrefaction and decay of organic substances is of like nature. The oxygen of the air enters into the composition with the changing matter and consumes it. Modern researches have led chemists to attribute this powerful action to that part of the oxygen termed ozone, discovered by Schönbein of Basel. Dr. Playfair made some ozone, and exhibited its action, and also the properties of its counterpart, antozone. He also showed the heat and light of the combustion set up, by passing the carbonic acid produced by fermentation through a tube in connexion with oxygen and ammonia. He next considered the means devised to detect and correct the great impurity of the atmosphere of towns, due

to the presence of organic matters emanating from decay, &c. The delicate air-test devised by Dr. Angus Smith, of Manchester, is formed of the solution of permanganate of potash (termed mineral chameleon), which has the property of losing its purple colour on the introduction of very minute portions of organic matter. The solution is poured into a flask of the air to be examined till its colour is unchanged, the quantity required indicating the state of the air. [Dr. Smith gives as results of experiments:—The organic matter in the air of Lake Lucerne, 1·4; Hospice St. Bernard, 2·8; German Ocean, 3·3; Manchester, 48·58; (close places), 60·7; Highgate (with wind from City), 12·3; Thames (at City, hot weather), 58·4; fields in summer, 10 to 12; London (after a thunder-storm), 12·3; air over a pigsty, 109·7.] Dr. Playfair gives the air on the top of the Calton-hill, Edinburgh as 12; while the Cowgate closes of that city are as 40. Deodorizers and disinfectors formed the next topic. The former, he said, merely mask the evil smell. Air may be fragrant with scents yet charged with deadly impurities. Disinfectants, however, actually destroy the organic matter in the air by slow combustion. This is the case with chlorine, sulphurous acid gas, and acid vapours. The disinfecting property of charcoal (due to the oxygen absorbed into its pores) is now well known in Dr. Stenhouse's air filters and respirators—some of which were shown. Porous earth acts in a similar manner in promoting rapid and inoffensive decay. In conclusion, Dr. Playfair contrasted the functions of the animal and vegetable kingdom—the one living and growing on the products of the other—exemplifying the fact that there is no waste in the world of nature. The vegetable, as a fixed apparatus of reduction, evolving oxygen, absorbing electricity and heat, decomposing carbonic acid and water and ammonia, producing organic substances by the transformation of inorganic matters derived from the earth, is in all these respects a perfect contrast to the animal. In the succession of changes thus perpetually going on it is impossible to say to what objects we may be indebted for the constitution of our own bodies.—*Illustrated London News.*

PEPSINE.

A COMMUNICATION to the French Academy of Medicine has been received from Mr. Hogg. When the stomach, from debility or illness, does not produce Pepsine in sufficient quantity, the digestion is imperfect and painful. Hence, pepsine, according to Mr. Hogg, in the hands of the physician, resolves one of the most difficult problems of human physiology. By mixing pure pepsine in a vessel with meat or other aliment the act of digestion is produced in precisely the same manner that it takes place in the stomach of a person in good health. Pepsine is prepared from rennet-bags (the stomachs of ruminating animals) carefully washed, and the mucous membrane removed by scraping, then digested during 24 hours in distilled water and filtered. A solution of acetate of

lead is then passed through the solution, and the precipitate washed with sulphuretted hydrogen, filtered, and dried in a temperature of +40 degrees of Centigrade. The dose of pepsine thus prepared is a few grains, taken before and after meals. "In the administration of pepsine," Mr. Hogg says: "medical men have experienced great difficulties, inasmuch as this substance, valuable as it is when freshly prepared, becomes entirely inert by exposure to the air. This is due to a kind of fermentation which takes place spontaneously, and which in a short time entirely destroys all the active principle." Powders, syrups, lozenges, wines, &c., have all been employed, but these forms of taking pepsine are open to many objections, for in all the pepsine is continually exposed to the action of the air. Another and decidedly the best form in which to administer this valuable remedy is in pills, formed, as Mr. Hogg recommends, of a nucleus of pepsine immediately enclosed in a coating of sugar and balsam of tolu, which prevents any contact with the air. Pepsine will thus retain its virtues unchanged during a long period.

BENZOL, ANILINE, MAUVE, AND MAGENTA.

Dr. A. W. Hofmann has read to the Royal Institution an elaborate paper on "Mauve and Magenta, and the Colours derived from Coal." The starting-point of this new branch of industry was the manufacture of coal-gas, the principal features of which were explained. The distillation of coal was performed in a glass retort, and the gas collected in a glass gas-holder, the gas tar being condensed in a small glass globe and collected in a glass flask placed between the retort and the gas-holder. Abandoning the gas and coke as not pertaining to his subject, the lecturer proceeded to explain the chemical nature of the coal-tar by the aid of large diagrams. The number of compounds separated from it is daily increasing, owing to the fact of their formation being due to the influence both of the temperature of distillation and the composition of the coal, which was shown by a diagram to vary to a considerable extent.

Dr. Hofmann next endeavoured to give a popular idea of the nature of destructive distillation. After referring to some of the principal types of matter which chemists have recognised, such as hydrogen, water, and ammonia, he produced three wire frames, which when filled with cubes of different colours represented these types. By taking the atoms of hydrogen, oxygen, and nitrogen out of these type-moulds, and replacing them by atoms of chlorine, sulphur, and phosphorus, the relation of hydrochloric acid and of sulphuretted and phosphoretted hydrogen to hydrogen, water, and ammonia were explained. In a similar manner, the insertion into the type-moulds of cubes representing the compound atom ethyl, the formation of ethylated hydrogen, of the ethylated waters, alcohol and ether, and of the three ethylated ammonias were exhibited. By substituting cubes which represented the compound

atom, phenyl for the ethyl; Dr. Hofmann showed the constitution of phenylated hydrogen (benzol), phenylated water (phenol), and of phenylated ammonia (phenylamine or aniline)—the three bodies chiefly concerned in the manufacture of colours from coal-tar. He then proved experimentally the formation of hydrogen, water, and ammonia in the distillation of coal, and explained how all the numerous bodies existing in coal were formed by the substitution of compound atoms, consisting of carbon and hydrogen for the hydrogen in the types.

The quantity of aniline in coal-tar being very small, the possibility of obtaining it from benzol was next considered; and the transformation of the latter into nitro-benzol by means of nitric acid, and, lastly, of nitro-benzol into aniline by means of iron and acetic acid, was illustrated by experiments. On adding a solution of chloride of lime to aniline the liquid was shown to assume a deep *mauve* colour. This colour has long been used by chemists as a test for aniline; but a few years ago Mr. W. Perkin had the happy idea of investigating the circumstances under which this colour, so remarkable for its instability, could be obtained in a permanent state, and applicable for dyeing purposes. This result he obtained by oxidizing aniline with bichromate of potash and sulphuric acid, and the colour thus obtained, known by the name of *aniline purple*, has been highly prized as a dye—its value being weight for weight equal to that of platinum. (A magnificent piece of aniline purple and solutions of various strengths, contributed by Mr. Perkin, were exhibited.) The composition of the colour was as yet unknown, and its formation unexplained. By oxidizing aniline by means of other agents than chromic acid—such as nitric acid, nitrate of mercury, chloride of tin, &c.—the beautiful crimson dye called *magenta* is produced, as was shown by experiment.

Aniline crimson, originally observed during scientific inquiries, was first prepared on a large scale by Verguin, and has since been largely manufactured in France and in this country; and to Mr. Nicholson, of the firm of Maule, Simpson, and Nicholson, is due the credit of having brought this branch of industry to its present state of perfection. The chemical nature of magenta is better known than that of mauve. Magenta (named by chemists rosaniline) is a base, colourless in the pure state, but when combined with acids yielding beautiful salts of a magnificent green lustre, like that of the wings of the rose-beetle, and, when dissolved in water, the splendid colours of magenta. Dr. Hofmann showed these phenomena by preparing the acetate of rosaniline, and exhibited a magnificent specimen of this extraordinary body in the form of a crown, which Mr. Nicholson had grown in a solution containing about 8000*l.* worth of magenta.

The rest of the lecture was devoted to a series of experiments illustrative of the manner of dyeing with the new dyes. Wool, silk, and fabrics, consisting of linen and wool or linen and silk, were dyed not only with mauve and magenta, but also with a new

purple colour lately discovered by Mr. Nicholson. In referring to the morale of the subject, Dr. Hofmann reminded the audience that benzol, the chemical basis of the new colours, was discovered in the laboratory of the Royal Institution by Professor Faraday in 1825, and showed the original specimen. He referred to the production of mauve and magenta as illustrations of the practical results which almost invariably follow pure scientific research.—*Illustrated London News.*

CALICO-PRINTING.

DR. LYON PLAYFAIR, in one of his lectures, delivered at the Royal Institution, on the Chemical Arts, described the processes of Calico-printing, and its manufacturing processes.

Among other chemical improvements in the art, Dr. Playfair referred to the substitution of phosphates and arseniates for cow-refuse; and at the same time severely censured those manufacturers who suffered their dangerous waste products to be ejected into streams, the water of which was used for drinking, and expressed a hope that the Earl of Derby's motion on chemical nuisances might lead to beneficial results in their abatement by Government inspection.

Dr. Playfair's next lecture was devoted to the new styles and processes lately introduced into calico-printing. The animal substances, silk and wool, have a strong affinity for colours, and are therefore easily dyed; while calico cannot retain soluble colours in its pores; hence the necessity for mordants which render the colours insoluble, and thereby permanent. By skill in varying and applying these mordants, many changes of colour may be obtained from the same dyestuff. A great improvement has been made in calico-printing by the employment of albuminous mordants. At first patterns were printed in white of egg, and then put into the dye; but afterwards albumen obtained from cheese and from vegetable substances, such as cabbages and peas, was found to be quite as effective. Other great chemical triumphs have been the utilization of the waste from madder dyes by the application of muriatic acid and steam; the preparation from lichens of the mauve purple, and other colours (including the beautiful and expensive ultramarine, formerly derived from lapis lazuli); and the extraction of other beautiful dyes from Peruvian guano. Many of these, however, have been replaced by the coal-tar colours. In describing topical colours (*i.e.*, those actually stamped on the fabric), Dr. Playfair expressed a strong opinion against the arsenic greens, which easily rub off by friction. He states that a lady's dress printed with this material may contain arsenic sufficient to poison 150 persons, and even a flower-wreath may hold sufficient to kill five. These dresses are fatal alike to the maker and wearer. He concluded by referring to the great achievements of science recounted by him which had converted waste into wealth; adding, that in consequence of these discoveries

we should probably become exporters of dyes to the countries from which we have previously imported them. Many experiments and specimens illustrate the lecture.

NEW COLOURS.

Two new Colouring Matters, resulting from the oxidation of phenic acid, have been discovered by M. F. Fol, and are described by him in the *Repertoire de Chimie.* Without mordants one dyes silk and wool from a deep red to a delicate rose colour; the other gives the same materials a reddish-yellow tint, which becomes brighter on washing with soap. M. Fol states that he has obtained the popular colour rosaniline by heating aniline to the boiling point with fine powdered indigo blue in certain proportions. The aniline oxidizes by means of the indigo, and forms rosaniline and white indigo. When the indigo is dissolved in the aniline the mixture becomes rapidly violet, and the white indigo repasses into the state of blue indigo.

NEW BLUE AND GREEN DYES.

In the *Repertoire de Chimie Appliquée* for May will be found a note, by M. H. Köchlin, on a process for obtaining these Dyes by a combination of iron and lead, based on the attraction of two oxides. The details are too long for our pages, and involve, as the author says, scientific rather than commercial interests. Nevertheless, they may lead to useful applications, inasmuch as in the manufacture of Turkey reds, indigo, and other dyes, combinations of lead are reserved, which he usefully employed as mordants of blues and greens, which to this day are derived from the unsatisfactory Prussian blue.

M. Delrez-Gosselin, a chemist of Elbœuf (Eure), has made an important discovery, having composed a Blue Dye, which does not contain a particle of indigo. The colour produced is fine, and perfectly fast. Experiments have been made at the Ministry of War, and the composition was found to resist all the reactive tests applied to it. It will effect a saving of 60 per cent. over the use of indigo.

Cæruleum, a new blue dye, is described by M. Bleekrode in the *Journal de Pharmacie.* It covers well, does not become green by lamplight, and is not acted on by sunlight or by mephitic gases, by acids or alkalis, or by high temperatures, and, representing the blue of the sky, recommends itself well in a commercial point of view.

STAINING WOOD.

A new process of Staining Wood, and especially vegetable ivory, rose-colour, has been reported to the French Academy of Sciences by M. Monier. It consists in plunging the material

into two baths; the first bath, iodate of potassium, containing eighty grammes of the salt to the litre; the second bath, of bichloride of mercury, twenty-five grammes to the litre. The vegetable ivory or wood is left in the first bath for several hours, and then placed in the second, where it receives a beautiful rose colour. When dried in the air the substance is varnished. The baths may be used a great number of times without renewal. M. Monier has also obtained a beautiful chestnut colour on wood by the reaction of the sulpho-hydrate of ammonia on a salt of tin; for instance, the protochlorate. As in the preceding case, he makes use of two baths, in a cold state; by this method woods are stained in a few minutes.—*Illustrated London News.*

COLOURING FOR CONFECTIONERY.

A NEW Green for Confectionery, perfectly innocuous, may be thus formed:—Infuse for twenty-four hours 0·32 gramme of saffron in 7 grammes of distilled water; then take 0·26 gramme of carmine of indigo, and infuse it in the same manner in 15·60 of distilled water. By mixing the two liquids, a large quantity of a beautiful, strong, green dye may be obtained. Ten grammes of this solution will colour 1000 grammes of sugar. This dye may be kept for a long time by evaporating the liquor to dryness or transforming it into a syrup. The most beautiful green colour now used is formed by the dangerous preparations of copper or arsenic.—*Journal de Pharmacie.*

ANTIDOTE FOR STRYCHNINE.

IT is stated in the *Sydney Morning Herald* that a valuable sheep dog belonging to Mr. Martyn, J.P., of Murrurundi, having accidentally eaten of this deadly poison, a dose of arsenic was administered to abbreviate the animal's sufferings, but, strange to say, it had a contrary effect, and the dog recovered. The same peculiarity was observed on two several occasions.

ARSENIOUS ACID.

THE affinity of Arsenious Acid for colouring matters is the subject of a note by M. Scheurer-Kestner in the *Repertoire de Chimie.* To a boiling solution of arsenious acid in hydrochloric acid he adds a small quantity of a solution of saffron in water. After the liquor has cooled, the bottom of the capsule in which it has been operated on is found to be covered with red or yellow crystals, while the liquid itself is nearly decolorized. With sulph-indogitic acid the crystals take a fine blue tint. On adding to the saturated and coloured solutions a crystallizable salt, such as chloride of sodium or potassium, these last salts crystallize at the same time as the arsenious acid, and are very little coloured; while the crystals of the arsenious acid are distinguished by a very intense colour. This fact, says the author, should be noted by physiologists, as it will some day find its application.

ARSENIC IN STREAMS.

Dr. John Davy has read to the British Association a paper "On the question whether Oxide of Arsenic taken in very Minute Quantities for a long period is Injurious to Man." He gave an account of a small mountain stream in Cumberland, Whitbeck by name, which contains a minute quantity of arsenic, and which has from time immemorial been used by the inhabitants of an adjoining village without any marked effect, either bad or good, on man and other animals, with the exception of ducks, to which birds the feeding in it has proved fatal. The author attributed the innocuity of the stream to two circumstances; first, the extremely minute quantity of arsenic present; and, secondly, the little tendency that arsenic has to accumulate in the organs of animals—the duck probably having less eliminating power than others. He mentioned instances in which arsenic in equally small quantity, derived from rivers in the Lake District, had proved fatal to the char. He presumed that arsenic existed in many other streams, the water of which was used with impunity, the arsenic being derived from arsenical pyrites, a very common mineral, by the action of air and water, and as in the instance of Whitbeck, comparatively harmless, and this owing to two circumstances—the very slight solubility of the oxide in cold water, and the fact of the harmlessness of the oxide in infinitesimal quantities.

TEST FOR ARSENIC.

Dr. Letheby recommends the following method of detecting the presence of Arsenic in wreaths and dresses:—Put a drop of strong liquid ammonia (liquor ammoniæ the druggist calls it) upon the green leaf, or dress, or paper, and if it turns blue, copper is present; and copper is rarely, if ever, present in these tissues and fabrics without arsenic being also present—the green compound being arsenite of copper. I have tested papers and dresses in this manner more than a hundred times, and have never failed to discover arsenic when the ammonia changes the green into blue. It is, therefore, indirectly a very reliable test; and if every lady would carry with her, when she is shopping, a small phial of liquid ammonia, instead of the usual scent bottle, the mere touch of the wet stopper on the suspicious green would betray the arsenical poison and settle the business immediately.

ARSENICAL PAPER-HANGINGS.

A chemist has communicated to the *Times* the following results of his experiments to test various articles for the presence of Arsenic:—

"In the first instance, a physician of eminence procured me a quantity of green, flocky dust, literally brushed off the papered wall of a room in which some of his patients had slept, and to which

he attributed their complaints. A portion of this I mixed with twice its weight of black flux, and subjected to a red heat, in a proper tube. A thick white vapour—which I recognised as arsenic by its strong alliaceous smell—distilled heavily from it, and condensed in the upper part of the tube in a metallic form.

"In the next instance, I took some bits of a paper stained with a green-leaf pattern, belonging to a room in which, after sitting some time, I myself had felt a sort of nausea, which it was suggested might be occasioned by arsenic; and these pieces of paper I subjected to the same process, and found the poison, though in smaller quantities.

"But I obtained the most alarming results from portions of a green wreath and some sprigs of bonnet flowers obtained from a young lady. From these the heavy arsenic vapour rose in a dense white cloud, condensing on the tube in large quantities, and filling the room with a nauseating smell of garlic."

Dr. Orton, in his inspection of the house at Limehouse, in which four children had suffered from arsenical poisoning, proceeded as follows:—When his suspicions were awakened as to the probable source of the mischief, he advised the immediate removal of the paper. That the paper contained a large portion of arsenic was a fact beyond question, but that the deceased child had taken any of the poison remained to be proved. All Dr. Orton could then venture to assert was, that the symptoms attending the illness of this child, as well as of the three other children, as stated by the mother, were such, so anomalous, as to lead him to associate them, with irresistible force, to those connected with chronic arsenical poisoning.

Dr. Letheby received from Dr. Orton the stomach and viscera of one child, and also a certain portion of green paper. He found that the latter contained arsenic, loosely adherent, in the proportion of three grains to the square foot. There was no glaze, and the poison could be very easily rubbed off. He examined the stomach and viscera, but could not find arsenic. The symptoms described by Dr. Orton were those of arsenical poisoning. He had known effects of the same kind produced by the poisonous powder from such papers being absorbed and inhaled while floating in the atmosphere; though he could not trace arsenic in the system, yet he should say in the absence of disease that death might have been caused by arsenic. Owing to the absorption of the poison being gradual, it was possible that the traces might be wanting, though the effect would be fatal.

Dr. Hofmann, having carefully examined the green-colouring matter of some artificial leaves from a lady's head-dress, on analysis found that, in a single dozen of these leaves, there were ten grains of arsenic: so that in the ball-wreath of a lady there must be at least forty grains,—a quantity capable of killing twenty persons! The prevailing pattern of those beautiful green tarlatans so much in vogue of late for ball-dresses, according to Professor Erdmann, of Leipsic, consists of a judicious mixture of tarlatan

and "half its weight" of arsenic, in the form of "Schweinfurt green," loosely laid on with starch, and dusting off "in clouds" by the slightest friction! A ball-dress requires, it seems, about twenty yards, which contain 900 grains of white arsenic; and a Berlin physician has satisfied himself that sixty grains powder off from a single dress at a single ball! But the spectacle is a still more repulsive and fearful one when the poisoning of the poor people who manufacture such wreaths and dresses is also considered.

FOOD: ITS DESTINATION AND USES.

In the *Proceedings of the Royal Society* Mr. W. S. Savory has given an account of his experiments in relation to this subject performed upon rats and a hawk. Their diet was divided into three classes:—1, a non-nitrogenous, consisting of equal parts, by weight, of arrowroot, sago, tapioca, lard, and suet, which yielded only 0·22 per cent. of nitrogen; 2, nitrogenous—viz., lean veal, from which every visible particle of fat had been carefully removed, which yielded only 1·55 per cent. of fat; 3, a mixed diet—the two former combined. The weight, temperature, and general condition of the animals were especially noticed. The following conclusions were drawn:—Nitrogenous materials are not only calorifacient, but, at least under some circumstances, sufficiently so to maintain alone the requisite temperature. It is in the highest degree probable that, under certain circumstances, nitrogenous materials may prove directly calorifacient without forming tissue. Non-nitrogenous substances are, at least under some circumstances, directly calorifacient without entering into the composition of tissue of any kind. While non-nitrogenous food only is taken, all the nitrogen which is excreted in the urine, and more, may be accounted for by the disintegration of the original tissues, without assuming that any fraction is assimilated from any other source. While life cannot be maintained without nitrogenous food, even though every other kind be abundantly supplied, death in this case being due to loss of tissue, life, and even health and the normal temperature can be maintained, at least for a long period, upon diet almost exclusively nitrogenous with proper inorganic substances in which there exists only a small fraction of non-nitrogenous matter. Such a minute proportion of fat must be but a poor representative of non-nitrogenous food. Lastly, in these experiments the significant fact appeared, that while the weight, strength, and general condition of the animals varied very widely under different diets to which they were subjected, no considerable fluctuation was observed in their temperature. Even the slight variation from time to time recorded seemed rather to result from other causes than depend directly on the food.

ANALYSIS OF MILK.

Milk has been so often analysed that it would seem no further

facts could be elicited regarding this important liquid. Professor Boedecker, however, has completed a series of experiments conducted on quite a new principle. The question he proposed to himself was whether milk obtained at any hour of the day always presented the same chemical composition or not; and he has arrived at the result that the milk of the evening is richer by 3 per cent. than that of the morning, the latter containing only 10 per cent. of solid matter, and the former 13 per cent. On the other hand, the water contained in milk diminishes by 3 per cent. in the course of the day; in the morning it contains 89 per cent. of water, and only 86 per cent. in the evening. The fatty particles increase gradually as the day wears on. In the morning they amount to 2·17 per cent.; at noon, to 2·63, and in the evening to 3·42 per cent. This circumstance, if true, would be very important in a practical point of view. Let us suppose a kilogramme of milk to yield only the sixth-part of its weight of butter; then the milk of the evening may yield double that quantity. The gaseous particles are also more abundant in the evening than in the morning—from 2·24 they increase to 2·70 per cent., but the quantity of albumen diminishes from 0·44 to 0·31. The serum is less abundant at midnight than at noon, being 4·19 per cent. in the former case, and 4·72 in the last.

At a meeting of the Royal Dublin Society a paper has been read on the quality of the Milk sold in Dublin. There were twenty samples purchased in the poorer districts of the city and suburbs and analysed. The results were satisfactory. Water was the only adulteration found by the analysts. There was no chalk —no calves' or sheep's brains—"the quality was, generally speaking, extremely fair." In three districts the samples examined were found to be absolutely pure, and two of these districts were among the poorest in the city.

CHEMISTRY OF WINE.

PROFESSOR BECHAMP, of Montpellier, having been called upon to make many analyses of sound and unsound Wines, has communicated the results of his experiments to the French Academy of Sciences. M. Pasteur characterizes sound wine by its possession of glycerine and succinic acid; cream of tartar, and perhaps some free tartaric acid, exist in it naturally. Sugar is another constant ingredient in good wines, young and old. This last fact M. Béchamp thinks has not been sufficiently estimated. The chemical character of a turned wine is its containing no free sugar, and when it is much deteriorated, its loss of all sugar-making products, and also glycerine. All these principles, except glycerine, reappear in the form of lactic acid. After careful experiment, M. Béchamp asserts that the glycerine is changed into propionic acid. The paper, enriched with tables giving the names of the wines operated on, and the results, is printed in the *Comptes Rendus*. With regard to what is termed the *bouquet* of wines, M. Stracke

has published the results of experiments which lead him to think that it is not due to the intervention of the tartaric acid, as is generally supposed, but rather to the decomposition of the oil of the grape-stones under the influence of fermentation. He bases his opinion on the fact that a genuine bouquet may be obtained by fermenting pure sugar with clean yeast, adding an emulsion prepared from grape-stones, almonds, or nuts. The bouquet can also be obtained from stearic acid, and dissolved in starch-paste. It is essential that the oils should be in a state of emulsion before they are mixed with the sweet liquid.—*Illustrated London News.*

GALLIC ACID IN RED WINES.

THE presence of Gallic Acid in some Red Wines, long suspected by M. Mulder, has been proved by M. Simmler, who has experimented on the Red Wines produced in the neighbourhood of the Grisons. After treating the wine with isinglass to free it from tannin, he diluted the wine with water till it became sufficiently clear for the perception of the changes of tint. When he added sesquichlorate of iron a greenish-brown colour was produced, which on exposure to the air gradually passed to violet, and finally into black flakes. M. Nicklès, commenting on the above statement, states that in the Grisons the wine remains weeks and months with the stalks and husks. This easily explains the presence of gallic acid, which is a product of the decomposition of tannin. He adds that this does not occur in the red wines of Lorraine and Alsace, where a contrary course is adopted.—*Ibid.*

MORPHINE IN OPIUM.

THE quantity of Morphine in Opium is the subject of a memoir in the *Journal de Pharmacie*, by M. Guibourt. According to Dioscorides and Pliny, opium was formerly obtained from the black poppy; now it is principally taken from the white poppy, the capsules being principally received from Asia Minor, India, and Egypt. M. Guibourt, however, asserts that the former gives a very active opium, which may also be procured from the common red poppies of our gardens. Liquid opium extracted from the poppies contains from 20 to 53 per cent. of water. The value of opium consists in the quantity of the alkaloid morphine which it contains. Morphine is obtained in crystals from opium treated with alcohol and ammonia, nearly all the narcotine being separated. M. Guibourt gives a series of analyses of opium received from various places, showing the proportion of morphine contained therein to vary from 12·35 per cent. to 14·78. M. Guibourt states that the opium of commerce has been gradually deteriorating; that the opium of Smyrna, reputed the best, contains ordinarily only 3 to 6 per cent. of morphine; and that opium considered to be very good contains only from 8 to 9 per cent. Hence the necessity for further research.—*Ibid.*

FORMATION OF OIL IN OLIVES.

In a memoir by M. de Luca, read to the Academy of Sciences at Paris, he narrates a series of experiments which have led him to consider that the Oil is formed in Olives by the transformation of the sweet principle (or mannite) and the green substance (chlorophyl) which exist in the leaves, flowers, and young olives while green, but which gradually diminish as the fatty matter increases in the olive, and totally disappear when it contains its maximum of oil. The yellow leaves and ripe olives do not contain chlorophyl or mannite. M. de Luca suggests the possibility that the mutual action of these two substances may give rise to a new substance, which future researches may reveal.

REMEDY FOR THE BITE OF A RATTLESNAKE.

Mr. G. W. Kendall writes from Texas to a New Orleans newspaper, the following remedy which he applied to a man bitten by a Rattlesnake:—He held his left wrist, while two streams of blood flowed from one of his fingers, where the fangs of the serpent had pierced him. As the man had no tobacco, I told him to fill his mouth with salt, and with all his might suck the wound. I then held a cloth steeped in hartshorn on the wound, to counteract the working of the poison. I next put thirty drops of hartshorn into a glassful of whisky, and poured the whole contents down his throat. Five minutes afterwards I repeated the dose, and again in another five minutes. I had now administered a whole quart (?) of whisky, with ninety drops of hartshorn, and held it sufficient. For three-quarters of an hour he sat quiet, and spoke about the bite with indifference, while I continued to renew the application of hartshorn to the wound in the finger. He said it was too bad that he should die of the bite of a poisonous snake, while I was astonished he could remain unaffected after such a dose of whisky. After about an hour he began to laugh, then to whistle, then to sing, and finally attempted to dance. It was now all right. I knew that the whisky had gained the upper hand of the poison, and for the first time intoxicated him. Five minutes after he was drunk, slept for half a day, and in the morning was well and at his work.

ARTIFICIAL CAMPHOR

Is formed by the action of chlorine on the essence of turpentine. To distinguish it from the natural Camphor M. Dumont recommended as a reagent the employment of a solution of ammonia on camphor dissolved in alcohol. The alcoholic solution of natural camphor gives only a light precipitate, which is dissolved by agitation, while that of artificial camphor gives a large precipitate, which will not dissolve. M. Sauerwein thinks this test insufficient, stating that the precipitate formed by artificial camphor in alcohol

is more or less in proportion as the solution is more or less concentrated. He says that artificial camphor frequently contains chlorine. The determination of the presence of chlorine in camphor, which is easy, proves that it is artificial.

DROP APPARATUS.

A NEW Drop-counting Apparatus, invented by M. Salleron, is figured and described in the *Repertoire de Chimie*, accompanied by a table giving the names of liquids at the temperature plus 15 deg. Cent., the weight of one drop of each in grammes, the number of drops equal to one gramme, and the weight of twenty drops. The apparatus is composed of a small flask with a side tube, by which the liquid is poured out. The diameter of the spout from which the liquid falls drop by drop is determined for the weight of a drop of distilled water—*i.e.*, five centigrammes. Twenty drops of water thus collected weigh then exactly one gramme; and this exactness, it is said, is so great that these twenty drops always give the same weight, if care be taken to dry the external edges of the tube every time that the liquid is made to flow.—*Illustrated London News.*

MOLECULAR PHYSICS.

LIQUID bubbles have been produced in a novel manner by MM. Minary and Sire, of Besançon, by pouring a certain quantity of olive oil into about one-and-a-half or twice the quantity of concentrated sulphuric acid in a glass vessel. After brisk agitation by a glass rod a number of small bubbles quickly rise and disperse in the air; the larger ones (sometimes two centimètres in diameter) more frequently fall into the mixture after a slight ascent. After remaining in the air a short time the bubbles assume the colours perceived in ordinary soap bubbles. Further details will be found in the *Comptes Rendus.* The observers expect these facts may throw some light on obscure points in Molecular Physics.

BOILING SPRINGS.

CERTAIN Boiling Springs in New Zealand, analysed by Dr. J. Smith, of Sydney, are found to have a very similar composition to those of Iceland, at their antipodes. Of 193 parts:—Chlorine of sodium (common salt), 113·57; silica, 42·4; soda, 16; chloride of potassium, 6·67; sulphate of potash, 5·28: carbonate of lime, 1·66; alumina, 0·32. Solid bodies immersed in the water become petrified, and plants growing near partially so.

DISSOLUTION OF SILK.

M. OZANAM has stated to the French Academy of Sciences, that ammoniate of copper (Schönbein's liquor) is a solvent of cotton and cellulose, also of silk; while it requires only a short space to dissolve cotton, it needs several hours—varying from three to twelve—to Dissolve Silk, according to the quantity and proportions employed. He states that he has left wool more than fifteen days in contact with the ammoniate of copper without its undergoing

the least modification in its texture or resistance. Here is, then, a simple means of recognising in one operation a triple tissue of cotton, silk, and wool. The solution of silk, M. Ozanam states, is susceptible of many useful applications.

COLOUR OF WATER.

THE Colour of Water has been frequently discussed by physicists. Arago said:—"The reflected colour of water is blue and the transmitted colour is green;" and explained, "the green colour of the waves by considering them as prisms of water, of which one of the faces reflect white light, which is refracted by the following wave, and thus goes forth green." Bunsen asserts that water chemically pure is not colourless, but is of a pure blue colour. M. Wettstein, after minute chemical researches, states that the green colour is due to the presence of organic matters. M. Beetz has recently investigated the subject, and records his interesting observations in the *Bibliothèque Universelle* of Geneva, the results of which are opposed to the conclusion of Arago, and favour the opinion of Wettstein that the colour is due to minute particles of matter suspended in the water, modified by the colour of the sky and surrounding objects.—*Illustrated London News.*

CONGELATION OF WATER.

DR. ROBINET has addressed a curious communication on the Congelation of Water to the French Academy of Medicine. It is well known that the blocks of ice formed in the sea yield fresh water by liquefaction. When seawater or any saline dissolution is congealed, the pure water is separated in the form of ice, and there remains a concentrated watery solution of the saline matter. It is thus salt is economically obtained in the north of Europe. To increase the alcoholic strength of wine it may be subjected to artificial cold, whereby the water alone which it contains is congealed and the wine becomes richer in alcohol. By operating in a similar manner on potable water, Dr. Robinet has found that it loses nearly all its salts, whether soluble or not. The waters of the lake of the Bois de Boulogne having been subjected to the operation, the small quantity of calcareous and magnesian salts they contained were eliminated. The purity of the water obtained by this method is such that it may in many cases be used instead of distilled water.

PURIFYING WATER FROM LEAD.

IN a letter written some time ago by Dr. Faraday to Sir John Burgoyne on this subject, with reference to military stations near the sea, Dr. Faraday says: "There is much difference and uncertainty about the mutual action of Lead and Water in different cases. When rain-water falls upon surfaces of lead, it is apt to act on them; and the water thus contaminated, by standing exposed to

air, generally clears itself from the dissolved lead; the metal separating as a carbonated precipitate, and falling to the bottom. But when the sea spray has access to the leaded surfaces, the action of the rain-water is such that the dissolved lead does not separate in this way; or, if it does, only after a much longer time. It is such water as this that I recommend to be treated with carbonate of lime. Enough whitening or levigated chalk is to be mixed with the fluid to make it of the consistency of good milk (though more will do no harm), and the whole is either to be filtered or to stand until clear. I have never yet found any sample of water, poisoned as above, that was not freed from the lead by this process."

RESEARCHES ON SEA-WATER.

M. VINCENT, chief pharmaceutical chemist of the French Marine, has published in the *Annales de Chimie*, in a series of tables, the results of his investigations, carried on by means of bottles of Sea-water obtained from the Atlantic and Pacific Oceans, each bottle having duly marked on it the position and depth where taken, and the time when. Since the ocean currents greatly depend on the modifications in the density and temperature of the water, M. Vincent hopes that the skilful navigators, who are now pursuing this fruitful course of scientific application, will soon resolve the difficulties of a new science, and will soon say with a distinguished writer, that "the ocean is not a desert but an immense plain, furrowed by routes of which God himself has traced the course."

THE CONSTITUTION OF SEAWATER,

AT different depths and in different latitudes, has been examined by Prof. G. Forchhammer, of Copenhagen, whose remarks thereon have been communicated to the Royal Society, and appear in the *Proceedings*. He states that thirty-one elements have been found in Seawater—viz., oxygen, hydrogen, nitrogen in ammonia, carbon in carbonic acid, chlorine, bromine, iodine in fuci, fluorine in combination with calcium, sulphur as sulphuric acid, phosphorus as phosphoric acid, silicium as silica; boron as boracic acid, discovered by the author both in seawater and in seaweeds; silver, in the Pocillopora alcicornis; copper very frequent, both in animals and plants of the sea; lead very frequent in marine organisms; zinc, principally in sea plants; cobalt and nickel, in sea plants; iron, manganese, aluminium, manganesium, calcium, strontium, and barium, the latter two as sulphates in fucoid plants; sodium, potassium. These twenty-seven elements the author himself had ascertained to occur in seawater. The presence of the next four elements—viz., lithium, cæsium, rubidium, and arsenic, has been shown by other chemists. A few only of these elements have any notable influence on the quantitative analysis of seawater—viz., chlorine, sulphuric acid, magnesia, lime, patash, and soda. Assuming chlorine as 100, the mean proportion of the other

leading constituents is—sulphuric acid, 11·89; lime, 2·98; magnesia, 11·07; all other salts, 181·1. The mean quantity of solid matter in seawater M. Forchhammer found to be 34·394 per 1000. The ocean of the equatorial regions contains the greatest percentage of saline matter—due, no doubt, to greater evaporation; and the North Atlantic contains more salt than the South Atlantic, probably due to the prevailing influence of the Gulf Stream. In the sea to the east of Africa the quantity of saline matter slightly increases with the depth.

PHOTOLITHOGRAPHY.

A PAPER has been read to the British Association, "On a Photolithographic Process adopted by the Government of Victoria for the Publication of Maps," by Mr. J. W. Osborne. The process was first adopted by the Government in September, 1859, and has since been extensively used, and many hundreds of maps and plans produced by its means. The object of the process was the reproduction of drawings and engravings in black and white, without the gradations known as half-tone. For this purpose a perfect negative must first be obtained by the ordinary methods. From this a photographic positive is printed by the agency of light on paper which has received a coating of a mixture of gelatine, albumen, and bichromate of potash. The action of light on this compound is to render such parts as are subjected to its action insoluble in water. The positive so obtained is covered entirely by lithographic transfer ink. This done, the paper is floated, with its inked side upwards, upon a tray of boiling water. By this process the ink is fused, the albumen is coagulated, and the gelatine, not rendered insoluble by the action of light, is softened. When these effects are completed, gentle friction with a sponge removes the ink and the gelatine from all parts of the paper, except those which form the image to be produced. The resulting picture is a positive transfer, which is transferred to the stone in the usual manner employed by lithographic printers. The result is an image on stone from which any number of copies may be produced by the ordinary lithographic printing.

In the course of subsequent discussion it was elicited that one of the principal claims to novelty involved was the fact that Mr. Osborne's process was the first in which the image on the stone was effected by means of a transfer. The process of Colonel Sir Henry James, used at Southampton for the reproduction of ordnance maps, was analogous to it in this respect, but was first used six months subsequently to Mr. Osborne's process.

PHOTOZINCOGRAPHY.

SIR HENRY JAMES has accidentally made the important discovery that the paper prepared with the bi-chromate of potash and gum only, as described in the work on Photozincography published by

Messrs. Longman and Co., will, if only kept for a week or ten days in the dark, yield half tones, and consequently give us lithographic or zincographic prints from any photograph.

CARBON-PRINTING IN PHOTOGRAPHY.

THE Duc de Luynes's prize of 2000f. for a Carbon-printing process in Photography has been awarded to M. Poitevin, with a second prize of 600f. to M. Fargier. An Englishman (Mr. J. Pouncy, of Dorchester), who was recommended for a prize of 400f. on a former award of the Duke's trustees, was probably the first who actually produced a carbon picture, though M. Poitevin has greatly improved the process.

PHOTOGRAPHY ON WOOD FOR ENGRAVING.

MR. ROBERT MARTIN writes to the *Mechanics' Magazine*:—"To Photograph on Wood has long been held a desideratum, and at various times it has been announced to the world as accomplished. But from the peculiar properties of the material to be operated on, and certain indispensable requirements on the part of the engraver, it does not appear to have been so successfully achieved as to obtain a general application.

"Although photography is regarded by some as giving but a defective representation of nature (in comparison with the image depicted on the human eye), arising from the imperfections connected with the construction of the camera, as well as from the unequal action of light upon various colours, nevertheless, when taken as a whole, we obtain by its agency a larger amount of truth than can possibly be rendered by the most skilful artist.

"Having, as I believe, surmounted the various obstacles which hitherto seem to have prevented its use, I may be permitted to point in some directions where its application appears suited."

Wherever extreme minuteness or intricate and delicate forms have to be delineated, as in microscopic representations, botanical, anatomical, insect, reptile, or such like departments pertaining to science, it supplies a want not adequately met by hitherto existing means.

But not merely is it to be limited to what may be deemed the useful, but be extended also to the ornamental, reaching even to pictorial and subject art.

In portraiture (a branch so well understood by the public) it offers considerable aid, providing, as it does, an amount of individuality unequalled by the most consummate skill; and if additional qualities are desired, such as no chemical or mechanical operation is ever likely to effect, then it provides a basis for artistic taste and treatment, by which truth and ideal beauty may be combined. And in elaborate architectural design, or in mechanical work of every kind, it alike lends a helping hand.

Natural History.

ZOOLOGY.

SECRET POISONING.

PROF. HUXLEY has made to the British Association a most important communication on Secret Poisoning; in which he stated that although he had no wish to engender groundless suspicions, or excite unnecessary alarms, yet he was sorry to say he could not but repeat the statement he made last year in a paper on Slow Poisoning, read before the Royal Medico-Chirurgical Society of London—namely, that he believed the cases of secret poisoning that are discovered form but a small percentage of those that actually occur. Nay, more, he even went a step further, and declared that he not only believed that we magnified the difficulty of perpetrating the crime, but that we were also inclined to exaggerate the facility of its detection. No doubt modern discoveries in physiology and chemistry had enabled us not only to distinguish between the effects of poison and natural disease during life, but likewise to detect and extract the poison from the tissues after death. But modern discoveries had also made known to us many poisons with which we were hitherto unacquainted. It was in toxicology as in naval warfare: no sooner was a projectile discovered, that is, considered irresistible, than our engineers set about discovering armour plates more invulnerable than their predecessors. So, no sooner does the criminal find a new poison that he can use with impunity, than the experts set about discovering a means for its detection. Dr. Harley remarked that the great desire of the poisoner was to get hold of a poison the effect of which would so closely resemble that of natural disease as to be mistaken for it. Fortunately, however, this was attended with extreme difficulty, as the effects of poison were generally sudden in their onset and rapid in their termination, for the poisoner seldom had time or opportunity of administering the poisonous agent in so small a quantity and for such a length of time as is requisite to produce an artificial state of disease, which may be mistaken at least by the accomplished physician for real disease. It had been asserted that in all cases of poisoning, where death occurred, the poison ought to be found in the tissues after death. Professor Harley, however, pointed out that this was not strictly true; for even in the case of arsenic, which was supposed to be the most persistent of all poisons, if the patient only lived long enough, the mineral might be entirely eliminated by the excretions before death, and afterwards not a trace remain to be detected in the body. Such occurred in Alexander's case, when, although it was known that arsenic was the poison which caused the death, none

was found in the body. Alexander, however, did not die till the sixteenth day. For this and other reasons the author then said, "that as the not finding poison in the system after death is no absolute proof that the patient did not die from its effects, the symptoms observed during life, in conjunction with the morbid appearances observed after death, even when no poison is discovered by chemical analysis, ought to be sufficient to convict the prisoner. And even the symptoms alone, if there be good circumstantial evidence, especially if combined with proof of a motive, ought to convict, just as was done at Palmer's trial." The Professor concluded by saying, that in all cases of suspected murder great care should be taken to avoid telling the persons around the patient of the suspicion. The patient himself should be the first confidant, for if there was no motive for suicide, he was the most likely to be aware of a motive in the persons surrounding him. The next confidant should be the doctor, who, by obtaining some of the secretions and having them carefully analysed by a competent person, would soon be enabled to decide if it was a case of secret murder, and perhaps also even to detect the criminal.

TOBACCO SMOKING.

DR. SMITH has read to the British Association a paper "On Tobacco Smoking: its Effects upon the Pulsation." He had ascertained that Tobacco-Smoking causes a large increase in the rate of pulsation in some persons, while in others no increase occurs, and hence that there is a diversity in the mode of action of this substance as there is in the admitted good or evil effects upon the body. He pointed out that the only period in which the inquiry could be made is at about 10 p.m., when there had been no food taken after 6 o'clock, since at that period the rate of pulsation naturally falls, and an increase could be due to the tobacco only. He had experimented upon Mr. Dale and other medical men at Scarborough, and had found that the effect upon Mr. Dale was as follows:—During the first six minutes the effect was very small, only an increase of four beats per minute; but after that period there was a steady and rapid increase until the 21st minute, when the tobacco was consumed. The average increase from the 6th to the 13th minute was 19 pulsations, and thence to the end of the experiment was 31¼ pulsations per minute. But the total increase in one minute was 37½ pulsations. Whether a further increase would have been attained, was not ascertained; but from the order of the increase it was probable that such would have occurred within narrow limits. It was found that after the smoking had ceased the rate of pulsation fell in a few minutes, but it yet remained 10 or 15 pulsations higher than was natural for two hours. There was less effect produced upon the pulse when the tobacco was smoked in a hookah. In this class of cases tobacco acts as a stimulant, and may supply to the literary man the state of system at night which would be induced by a moderate quantity of alcoholic stimu-

lants; but when the body is of full habit, it must lead to disturbed sleep, and may lead to apoplexy.

NEW REMEDY FOR SMALL-POX.

THE *Saracenia purpurea*, or Indian cup, a native plant of Nova Scotia, the specific used by the Indians against small-pox, bids fair to realize the expectations entertained by medical men of its efficacy. In a letter addressed to the *American Medical Times*, Dr. Frederic W. Morris, President-Physician of the Halifax Visiting Dispensary, states that this *Saracenia*, a papaveraceous plant, will cure small-pox in all its forms within 12 hours after the patient has taken the decoction. "However alarming and numerous the eruptions," he says, "or confluent and frightful they may be, the peculiar action of the medicine is such that very seldom is a scar left to tell the story of the disease. If either vaccine or variolous matter is washed with the infusion of the *Saracenia*, they are deprived of their contagious properties. So mild is the medicine to the taste that it may be largely mixed with tea and coffee, and given to connoisseurs in these beverages to drink, without being aware of the admixture. The medicine has been successfully tried in the hospitals of Nova Scotia."—*Galignani's Messenger*.

WENS.

A COMMUNICATION has been received by the French Academy of Sciences from Dr. Guyon, showing the efficacy of a change of climate as a cure for wens. He states that in 1858 a Belgian consul who had been staying some time at Lima went to Santiago, in Chili, with his wife and two daughters, one of the age of 10, the other 12. They had not been there more than 15 months, when incipient wens were discovered on the children, while neither of the parents, owing probably to their maturer age, had any symptom of the kind. Alarmed at this, the father consulted the physicians of the country, who all unanimously advised a change of climate. The mother accordingly embarked with her two daughters on board the first vessel bound for Europe. The voyage, which was predicted to last 60 or 70 days, was protracted to 110. The passengers suffered much, both from seasickness and the changes of temperature they had to undergo in passing from the latitude of Cape Horn to that of the Equator. During the passage the children would often mechanically pass their hands over their necks, and thus soon perceived that their tumours were visibly decreasing; so that on their arrival at Cherbourg the wens were half gone. From Cherbourg the ladies went to Brussels, where the last vestiges of the affection disappeared. The physicians of Santiago in proposing the remedy, must have had numerous proofs of its efficacy. Dr. Guyon also mentions the case of a considerable number of Swiss emigrants from the Valais, who in 1858 settled in Algeria, where they built four hamlets, called Zoug-el-Abbes, Berbassa, Saeegha, and Chaeeba. Most of them, the women especially, had wens; but they had not been a year in the country

before they became aware of a considerable decrease in the size of the wens, and by the end of 1856 they had all disappeared.

BIOLOGICAL SCIENCE.

PROFESSOR HUXLEY, president of the Section of Zoology and Botany, at the British Association Meeting, in his inaugural address, first described the nature and clearly defined the objects of the science. He subdivided the science into the four heads of morphology, physiology, distribution and ætiology, or investigation of the laws which concern the origin, development, and extinction of all organic beings. He narrated the history and progress of each branch, and specially adverted to the fact that almost all the valuable progress had been made during the last fifty years. In the lifetime of the present generation he anticipated a still more brilliant and startling progress. In connexion with the last branch he passed a graceful encomium on the labours of Mr. Darwin, whose name was received with a burst of applause. The Professor emphatically affirmed that Mr. Darwin's work was as perfect in its logical method as it was accurate in its scientific facts. He concluded by inculcating the importance of promoting the advance of biological science, and insisting on the advantages which had been already attained by the examinations conducted by the Department of Science and Art. He made a warm appeal to the Universities of Oxford and Cambridge no longer to confine their fellowships and the other great advantages of their endowments to success obtained in classics and mathematics. He trusted that before long biological science would receive a practical recognition in both Universities.

THE DEAF AND DUMB.

A PAPER has been presented to the French Academy of Sciences by Dr. Boudin, in which, after expressing his belief that Surdomutism may henceforth be considered as one of the probable consequences of marriages between near relatives, he decidedly opposes the view adopted by some, who consider the infirmity in question to be hereditary. The parents of deaf and dumb children, he observes, are generally in perfect health, and moreover, deaf and dumb parents not connected with each other by ties of consanguinity very rarely get deaf and dumb children. He then quotes an observation made by Dr. Perron, of Besançon, of two brothers of the name of Vallet, splendidly constituted and enjoying the most perfect health, who married two sisters, their cousins-german. The eldest has had several children, only one of whom, now aged twenty, is deaf and dumb. The younger brother has had six children, the first, third, and fifth of whom could hear and speak, while the second and fourth were deaf and dumb; the sixth, still in its cradle, does not seem sensible of any noise they may happen to make in the room. These cases are utterly in contradiction with the doctrine of inheritance.

"ORIGIN OF SPECIES."

In a review of Mr. Darwin's work on Orchids, in the *Edinburgh New Philosophical Journal,* No. 32, the writer concludes as follows:—

In these passages (quoted by the reviewer), we see the bearing of the facts of Orchid fertilization on the production of new forms, as propounded by the author in his work on the "Origin of Species." He traces all modifications through successive generation, and thinks that this is a better view of the case than to suppose that the Creator at once called into existence the varied forms of the present flora. He thinks that if we could trace back floral forms from generation to generation for long epochs, extending it may be over millions of years, we would be able to account for all variations in a more philosophic manner than by referring them to one creative fiat of the Almighty. He deprecates the idea of M'Cosh and others, that in these modified forms of great types the Creator displayed the plan and order of His work, and that in the abnormalities in the forms of organs and their gradation God has shown the principles of His arrangement, and has developed the workings of his all-creative mind. For our own part, we do not see the great superiority of the Darwin view over this latter hypothesis. Both are, no doubt, theoretical. The obstacles to the reception of Darwin's hypothesis in its full extent are great. To believe that all the forms of animals and vegetables spring from a cell, which through countless millions of ages has undergone an infinite series of transformations by natural selection, correlation of growth, struggle for life, &c., is certainly not an easy thing for the mind, more especially when *man* is included in the category. Here it is that the difficulty occurs; and it is precisely at this latter stage that the opponents of Darwin's views have a sure foundation to rest upon. For here Revelation steps in, to tell us of man's creation, of his relation to the Deity, of his present fallen condition, and of his future prospects, and speaks in such terms as to preclude the possibility of our adopting the Huxleyan view, that, as the lowest ape, in the conformation of its skeleton, differs as much from the highest ape as the latter does from man, therefore we are merely transformed apes.

In his work on Orchids, however, Darwin does not stretch his view to this limit. He details facts with the utmost candour, and then very plausibly shows how they might be accounted for on his view of transmission by generation. Setting aside all theory, and looking at the work in itself, we have no hesitation in saying, that it is one of the deepest interest, well worthy of being studied; that it presents forms and functions to us under new aspects; illustrates in no ordinary degree the beautiful adaptations which are seen in plants, and is calculated to exalt our ideas of the wonder-working Jehovah.

THE HUNTERIAN MUSEUM.

The Council of the Royal College of Surgeons has purchased from the International Exhibition some skeletons of rare and interesting animals, beautifully prepared by Professor Hyrtl, a distinguished Hungarian, now residing in Vienna. They consist of *Chlamydophorous truncatus,* found at Mendoza, in Chili, and first described by Dr. Harlan, from a specimen now in the Philadelphia Museum. It is supposed that there are but three skeletons of this curious little animal in Europe, which is very much like the *Glyptodon clavipes,* so familiar to the visitors to the College Museum. The late Mr. Yarrell described and figured the animal in the *Zoological Journal.* This, with a second specimen, obtained by Sir Woodbine Parish, is in the British Museum. The specimen now the property of the College has been the subject of an elabo-

rate memoir by Hyrtl. Another case contains skeletons of rare fish, including examples of the three genera of existing ganoid fish, *Lepidosteus*, *Polypterus*, and *Amia*, also a case of *Batrachians* (frogs and toads), two cases of tailed amphibia and snakes. These specimens have cost the College of surgeons nearly 200*l.* This department of the museum has also been recently enriched by some fine skeletons of large British fish, admirably prepared by Mr. James Flower, the College articulator, one especially, which will well repay a visit, being a fine specimen of the swordfish, upwards of ten feet in length, taken in October, 1861, off the Suffolk coast, in the herring nets, and at once purchased by the College.

THE ZOOLOGICAL SOCIETY.

According to the Report of the Council, presented in May last, the Society's affairs were in a very satisfactory state. The income amounted in 1861 to 16,072*l.*, which is in excess of the average receipts during the previous six years by more than 1000*l.*—the greater portion paid by visitors to the gardens in the Regent's Park. In Paris, and other continental cities, such institutions are either kept up by the Government, or aided from the national funds. Our Zoological Society, so far from obtaining assistance from the Government, is highly taxed by the latter—not only paying a large rent for the use of the land occupied in the Regent's Park, but also contributing very handsomely to Her Majesty's exchequer in the shape of income-tax. It stands to reason that the Society cannot be expected to open their gardens to the public gratis; although, as we have been informed, the First Commissioner of Works has more than once invited them to pursue this course, without offering to meet the deficiency that would thereby be caused in their income.

We gather from the Report that the total number of animals in the Gardens varies generally from 1400 to 1500 individuals. The stock of larger and more important quadrupeds has been considerably increased, principally through the collections of South African animals received from Sir George Grey, Governor of the Cape Colony, a most distinguished benefactor to the Society's establishment. During the past twelve months, a fine series of antelopes and other rare animals, in many cases new to the Society's collection, had been received. The Koodoo, the Bless-bok, the Grys-bok, the Stein-bok and the Harte-beest, besides others of less note, are amongst those thus procured. The list of animals exhibited for the first time in the Society's Gardens since the previous anniversary embraces the names of 8 Mammals, 15 Birds, 9 Reptiles, and 1 Fish. The living forms of 33 animals have thus, for the first time in most cases, been brought before the eye of the naturalist and observation of the student.

The two Paradise birds, which the Society received through the exertions of a well-known traveller and man of science—Mr. A. R. Wallace—are justly considered to be one of the greatest prizes

in the way of novelties that have been obtained for many years. Several attempts have been made by our neighbours in Holland, who boast of a collection of living animals second only to that in the Regent's Park, to secure examples of these magnificent birds to grace their aviaries, but always without success. After the disappointment about the Python's eggs, something was certainly wanted to calm the wounded feelings of the Fellows, who were anxiously counting their little serpents before they were hatched; and a more charming solace than these beautiful birds could not have been provided for them.

The success attained by the Zoological Society in their efforts to perpetuate their breeds of African Elands and Himalayan pheasants in this country during the past season, seems to have been likewise encouraging as to the ultimate results of these experiments. Each of the three females of the first-named animal retained by the Society for "stock" produced a calf during the past twelve months, and that the mothers and their respective infants are enjoying sound health may be ascertained by any one who chooses to visit the Society's Eland house, and inspect the little herd standing at ease in the adjoining enclosure. The pheasants bred rather more abundantly than in the year 1861, fifty-four young birds having been successfully reared instead of forty-five.—*Abridged from the Saturday Review*, May 17, 1862.

The following are among the other additions to the Gardens in the Regent's Park:—

Mr. W. R. Broughton, the steward of the ship La Hogue, from Sydney, brought with him a large number of birds, several of which were not only new to the collection, but before unknown. A portion of the birds was sent over to England by Dr. Bennett, a corresponding member of the Society at Sydney, and the others were the private property of the steward. Dr. Bennett shipped a pair of extremely rare hornbills. When the ship was off Gravesend the female unfortunately died, but the male bird arrived in perfect health and in admirable condition. As the first of the kind ever seen alive in Europe it will command attention, but its very peculiar appearance cannot fail to strike the beholder.

There is also a very interesting bird from New Caledonia, called by the natives the kagu, resembling the sun bitterns of South America in some respects, but of a species new to the collection. There is likewise a blue water-hen and a very fine "fruit-eating" pigeon.

Perhaps the most attractive of the additions is a pair of large white cockatoos, of a species hitherto unknown in Europe. They are natives of the South Sea Islands, and were brought to Sydney as the depôt whence rarities are brought from that quarter of the globe. Their distinguishing peculiarity is a blue ring encircling the eyes, which thus have the pretty look of being set in turquoise.

There are also four or five beautiful Australian parrots, and some new finches from Queensland, of exquisite beauty, the only ones as yet brought to England alive.

THE PYTHONESS IN THE ZOOLOGICAL SOCIETY'S MENAGERIE.

This member of the great Boa family afforded much *matériel* for speculation during the London season of 1862. The Python was born in Western Africa, and had been eleven years in the Gardens, during which it had thriven well, waxing yearly in strength,

girth, and length. She had a male companion. One day, after her plethoric condition had excited some uneasiness, the boa excluded about 100 eggs, enclosed in a white leather-like substance, about the size of those of a goose, the majority of a dirty-white appearance, connected by a membrane. Among them were two small red eggs, and many were indented, probably by the great pressure of the serpent's body. It is remarkable that this prolific exclusion of eggs, which might be supposed to have exhausted the animal, and consequently excited hunger, had apparently an opposite effect. These details are condensed from a lengthy account in the *Athenæum*. The Pythoness had not taken food for 27 weeks, when she changed her skin. However, to make a long story short, the incubation failed.

ACCLIMATIZATION.

WITH the fullest wish to encourage the introduction of plants and animals new to this country, we are disposed to regard some of the exertions made in print for this purpose to be "more cry than wool."

This remark does not apply to the Acclimatization Society, who have practically illustrated their object by giving a public dinner, at which the following was the *carte*:—

POTAGES.—*Birds' nest soup (China), *tripang, or bêche de mer (Japan), *semoule (Algeria), *neufs de daim (Cochin China), purée de pois, mock turtle à la Reine, crécy au ris, consommé à la Princesse, à la bisque aux écrevisses.

POISSONS.—Tranches de saumon racollées, saumon de Perth, rougets, whitebait, truite à la Tartare, turbot à la sauce.

ENTREES.—*Kangaroo steamer (Tasmania,) *pepper pot (West Indies), kromiskys à la Russe, suprême de Vollaile à l'ecarlate aux haricot verts, ris de veau à la chicorée, côtelettes d'agneau aux petits pois, *poulette en karie à la Siamoise, *ris de veau à l'oseille de Dominique.

RELEVES.—*Chinese lamb, *kangaroo ham (Australia), wild boar ham (Spain), ox tongue (New South Wales), petits poulets à la Maçedoine, selle de mouton, jambon de York, vol au vent au ragout à la Japonaise, quartier d'agneau.

ROTS.—*Syrian pig, *Canadian goose, *the Hon. Grantley Berkeley's pintail ducks, *guan (Central America), *curassow (Central America), *Honduras turkey, *dusky ducks, *couple of leporines (France), *Brent geese (Holland), oisons au jus, chapons au Cressons, canetons.

LEGUMES.—*Chinese yam, potatoes, peas, cauliflower, &c.

ENTREMETS.—*Sweet patates (Algeria), sea weed jelly (Queensland), petits pois à l'Anglaise, gâteau condé aux pistaches, petites bouches à la crême, suédoise aux fraises, asperges en branche, gelée d'ananas, bavaroise à la vanille, petites cupes de groiselle, gelée de mille fruits.

HORS D'ŒUVRES.—Lobster salad, *Digby herring salad, *botargo (Ionian Islands), &c.

RELEVES DES ROTS.—Soufflé glacée, babas à la polonaise.

GLACES.—Fraise, ananas, orange.

DESSERT.—Cerises, fraises, *dried bananas (Ile de Réunion), *preserved pine apple (Isle de Réunion), *bibas (Isle de Réunion), *preserved cassareep, *Guava jelly, *Rosella jelly (Queensland), *Australian biscuits, *meat biscuits (Australia).

VINS ET LIQUEURS.—Port, sherry, claret, champagne, Moselle, Erbach; Australian wines (presented by Sir Redmond Barry), *hermitage, *chablis, *ceres Burgundy, *red Burgundy, *white Longfield wine, *hock, *Sauterne, *white Victoria, *Ancorat, *red Victoria, *sweet water; wine from New South

Wales (presented by Sir Daniel Cooper); Camden wine, New South Wales (presented by L. Mackinnon, Esq.); *pine apple wine (Queensland), *plum wine (Queensland), *vin de pommes d'Acajou (Guadeloup), *vin d'oranges (Guadeloup), *"Qued Allah" (Algeria), *liqueur Amér (Algeria), *nectar de Garibaldi (Algeria), *chartreuse (Algeria), *crême de citron (Ionian Islands), *crême d'orange (Ionian Islands), *rosoleon (Ionian Islands), *mentha (Ionian Islands), *vino de vino pasta (Ionian Islands), *muscat (Ionian Islands), *rum (Martinique).

TEA, COFFEE, &c.—Ayapana tea (Réunion), cassia orientalis coffee (Réunion).

The "transactions" of the Society, within eighteen months, were thus stated by Lord Stanley, who presided at the Dinner:—

The Society had already imported from the United States the prairie grouse, a new variety of turkey from Honduras, the guillemot from Norway, the guan and curassow from other countries. Of fish they had introduced the Murray cod, said to be something between a pike and a perch, and better than either; the Chines sheep, which were excellent eating and excellent breeders. The Marquis of Breadalbane had introduced the Bison, and he had now a large herd of them; and Lord Hill had been very successful with the Eland. Of vegetables they had introduced the Chinese Yam, which took so kindly to English earth that it was said to be exceedingly difficult to get the roots out of it; the Ilanthus, which was found to be excellent food for silkworms, had also been introduced, and had grown well in St. James's-square, and thousands of silkworms were now growing upon the tree.

MAN AND THE GORILLA.

A PAPER has been read to the British Association, "On the Zoological Significance of the Brain and Limb Characters of Man, wit Remarks on the Cast of the Brain of the Gorilla," by Prof. Owen.

The Professor exhibited two casts, one of the human brain, which had been hardened in spirits, and had therefore not preserved its exact form; but to all intents and purposes it would serve as an illustration of the human brain. The other cast was taken from the interior of the cranium of the gorilla. From an examination of these, the difference between the brain of man and that of monkeys was at once perceptible. In the brain of man, the posterior lobes of the cerebrum overlapped, to a considerable extent, the small brain, or cerebellum; whereas in the gorilla, the posterior lobes of the cerebrum did not project beyond the lobes of the cerebellum. The posterior lobes in the one were prominent and well marked: in the other, deficient. These peculiarities had been referred to by Todd and Bowman. From a very prolonged investigation into the characters of animals, he felt persuaded that the characters of the brain were the most steadfast; and he was thus induced, after many years of study, to propose his classification of the mammalia, based upon the differences in the development of their brain structure. He had placed man—owing to the prominence of the posterior lobes of his brain, the existence of a posterior cornu in the lateral ventricles, and the presence of a

hippocampus minor in the posterior cornu,—in a distinct sub-kingdom, which he had called Archencephala, between which and the other members of the mammalia the distinctions were very marked, and the rise was a very abrupt one. The brain, in his estimation, was a far better guide in classifying animals than the foot; but the same difference that existed between their brains was also observable between their feet. The lecturer referred to a diagram which represented the feet of the aye-aye, the gorilla, and man, pointing out the chief differences in the structure of the skeleton. These differences he considered sufficiently great to elevate man from the sub-kingdom to which the monkeys belonged, and to place him in a distinct sub-kingdom by himself.

Prof. Huxley observed that the paper just laid before the Section appeared to him in no way to represent the real nature of the problem under discussion. He would therefore put that problem in another way. The question was partly one of facts, and partly one of reasoning. The question of fact was, What are the structural differences between man and the highest apes?—the question of reasoning, What is the systematic value of those differences? Several years ago, Prof. Owen had made three distinct assertions respecting the differences which obtained between the brain of man and that of the highest apes. He asserted that three structures were "peculiar to and characteristic" of man's brain—there being the "posterior lobe," the "posterior cornu," and the "hippocampus minor." In a controversy which had lasted for some years, Prof. Owen had not qualified these assertions, but had repeatedly reiterated them. He (Prof. Huxley), on the other hand, had controverted these statements; and affirmed, on the contrary, that the three structures mentioned not only exist, but are often better developed than in man, in all the higher apes. He (Prof. Huxley) now appealed to the anatomists present in the Section whether the universal voice of Continental and British anatomists had not entirely borne out his statements and refuted those of Prof. Owen. Prof. Huxley discussed the relations of the foot of man with those of the apes, and showed that the same argument could be based upon them as on the brain: that argument being, that the structural differences between man and the highest ape are of the same order and only slightly different in degree from those which separate the apes one from another. In conclusion, he expressed his opinion of the futility of discussions like the present. In his opinion, the differences between man and the lower animals are not to be expressed by his toes or his brain, but are moral and intellectual.

Prof. Rolleston said he would try and supply the members of the Association with the points of positive difference between the human and the ape brain. For doing this we had been abundantly shown that the hippocampus minor and the posterior lobe were insufficient. As differentive, they must be given up at last. But as much had recently been done for the descriptive anatomy of the brain by Gratiolet and others as had been done for astronomy by

Stokes and Adams, for language by Max Müller, and that this had been ignored in this discussion was little creditable to British science. This analysis of the brain's structure had established as differentive between man and the ape four great differences—two morphological, two quantitative. The two quantitative are the great absolute weight and the great height of the human brain; the two morphological, the multifidity of the frontal bones corresponding to the forehead, usually, popularly, and, as this analysis shows, correctly taken as a fair exponent of man's intelligence, and the absence of the external perpendicular figure. This had been abundantly shown by Gratiolet. No reference to these most important matters had been made by Prof. Owen; and this omission could not fail to put the British Association's repute for acquaintance with the works of foreign fellow-labourers at great disadvantage in the eyes of such foreigners as might be present. Prof. Rolleston concluded by saying that if he had expressed himself with any unnecessary vehemence, he was sorry for it; but that he felt there were things less excusable than vehemence, and that the laws of ethics and love of truth were things higher and better than were the rules of etiquette or decorous reticence.

Mr. W. H. Flower, looking at the subject solely in the anatomical view and as a question of fact, stated that the result of a considerable number of dissections of brains of various monkeys was that the distinction between the brain of man and monkeys did not lie in the posterior lobe or the hippocampus minor, which parts were proportionately more largely developed in many monkeys than in man, and that if these parts were used in the classification of man and the monkey the series would be,—first, the little South American marmosets; then would follow the baboons, the cercopithea, macaque; then man must be placed, followed by the anthropoid apes, the orang-outang, chimpanzee, and gorilla; and last, the American howling monkey.

Prof. Owen replied, that Prof. Rolleston had led the meeting to conclude that he had not paid any attention to the convolutions of the brain of mammals, and that the investigation of this subject was the exclusive property of the German anatomists; whereas he might be permitted to state that almost at the very time that Leuret wrote his memoir on this subject, he had delivered a course of lectures on the convolutions of the brain, which, he regretted, had not been published, owing to the pressure of other labours; but the diagrams were still in existence, as his successor could testify, in the Museum of the Royal College of Surgeons.

NEW SHEEP.

In the establishment of the London Acclimatization Society, at Clapham, is a flock of Sheep consisting of eighteen ewes and lambs, and four rams. These animals, which bear the name of Ong-ti, are of a middle size, rather high on the legs, and have no ears, or only the lower part of that organ, which gives them a rather singu-

lar appearance. Of the four rams, only one has horns, one bent backwards, and the other imperfectly developed as if injured. Their tails are large, short, and pointed at the extremity. The quality of the wool is in general short and coarse. These animals are very quiet, and would thrive well on dry, unfertile land. The ewes, in addition to lambing twice a year, have four, and even five at a time.

MERINO SHEEP.

THE *Lyttelton Times* (New Zealand) states that Rich's well-known flock of Merino Sheep had recently been disposed of, when the following prices were realized—36 imported pure-bred Spanish ewes, 996*l.*, two of them fetching 50*l.* each; six imported French ewes, 247*l.*; four hoggets out of Spanish ewes by French rams, 73*l.*; four ewes by imported Spanish ram out of French ewes, 124*l.*; three ewes of mixed French and Spanish blood, 59*l.*; five ewes and three lambs of the Mount Eden and Spanish flock, 105*l.*; 45 ewes of the same flock, 315*l.*; 34 pens, containing 173 ewes and lambs of the Mount Eden flock, 1368*l.*, 12 guineas per head being the highest price for any one pen of this lot. The ram flock was more spiritedly competed for, and the prices obtained were better:—Two imported pure-bred Spanish rams, each of which had taken first-class prizes in Germany, were bought in for 600*l.*; a pure-bred Spanish merino ram, imported, fetched 150*l.*; five Shakspeare rams, 100*l.*; two pens, containing 12 each of ram lambs by the above Shakspeare rams, 150*l.*; 28 pens, containing 219 rams, from two to four tooth, a portion by the Spanish merino ram out of the Mount Eden Saxon merino ewes, fetched from 5*l.* to 10*l.* 10s. per head, and realized 1408*l.* 14s.; a pen of three rams and one ewe lamb, 8*l.* 8s. per head; 12 rams, sold singly, fetched 279*l.*

THE ELAND.

DR. SCLATER, Secretary to the Zoological Society, writes to the *Times*:—Every one who has had experience of the meat of the Eland testifies to its excellence as an article of food, and those who know how well this antelope has thriven in the gardens of this Society, in Lord Hill's park at Hawkstone, and in other places where it has been tried, must be amply satisfied as to its perfect adaptability to our climate. But I think it can hardly be fairly said that the eland is long in attaining maturity, as in this respect it appears superior to the domestic ox. The eland is adult when a little more than two years old, and commences breeding at that period, which is certainly not the case with ordinary cattle until long past that age. Our elands produce their calves with great regularity every season, and each of the three females in this Society's gardens may now be seen accompanied by a young one. The male eland we now possess, which was bred by Lord Hill at

Hawkstone, is a little over three years of age. As he is the father of two of the young elands above mentioned, the eldest of which was born in December, 1861, and the female of this antelope goes nine months with young, it is evident that my statement as to the early maturity of this animal is correct in this case, and I believe it to be generally so.

THE BUFFALO.

DR. SACE has addressed a paper to the Société d'Acclimatation on the introduction of the Buffalo into France, which he considers to be far from advisable. The buffalo is an African animal, and thrives especially in hot and marshy countries, where it feeds on the coarse grass peculiar to such districts, with its body half immersed in water. The female calves every second year; its milk yields more butter and cheese than that of the cow, but it has a taste of musk, which is disagreeable to those not accustomed to it. The flesh of the Caramanian buffalo is tough and uneatable, while that of the Hungarian may pass for second-rate butcher's meat. All things considered, the cow is preferable to the buffalo, because it calves once a year, is easier to manage, and yields a more palatable milk than the other.

THE AYE-AYE.

THE Aye-aye (*Chiromys Madagascariensis*) is one of the rarest and least known of the monkey tribe, and is further remarkable for its extraordinary anomalous structure in several particulars, which induced Cuvier to class it amongst the rodents, or gnawing animals. The aye-aye was discovered by the French traveller Sonnerat, in the forests of Madagascar, during the latter part of the last century. It received its name from the expression of surprise said to have been used by the natives when it was first seen; for, according to Sonnerat's statements, it was hardly known even to the inhabitants of the island before the time of his visit. The two specimens of this animal thus obtained were transferred to the collection of natural history in the Jardin des Plantes at Paris, and remained for many years the only examples of their kind in Europe. In 1858 Dr. H. Sandwith (of Kars), then Colonial Secretary of the island of Mauritius, obtained a living example of the aye-aye from Madagascar, and read an interesting paper on its habits, as displayed in a state of captivity, before the Royal Society of Arts and Sciences of that colony. This specimen, being shortly afterwards sent to England, to Professor Owen, formed the subject of a very complete and elaborate memoir upon the structure of the aye-aye, which was recently communicated by that distinguished naturalist to the Zoological Society of London, and will be published in their "Transactions."

The Zoological Society have now also succeeded in obtaining the first specimen of this curious mammal that has reached Europe

alive. Mr. Edward Mellish, of the Mauritius, one of the gentlemen who formed the mission sent to congratulate the new king, Radama II., on his accession to the throne of the Hovas, knowing the interest that attached itself to the aye-aye, made great exertions to procure a living specimen.—*Illustrated London News.*

MINUTE VERTEBRATE ANIMAL.

DR. G. C. WALLICH has contributed to the *Annals of Natural History* a drawing of a lower jaw, the extreme length of which is the 100th of an inch. Assuming the body to have been five times as long as the jaw, he says, "Here we have evidence of the existence of a Vertebrate Animal measuring only the 20th of an inch—a size considerably below many of the organisms usually regarded as microscopic. The jaw was recently detected on a shell containing a specimen of muddy deposit dredged up at St Helena in 1857, in thirty fathoms of water, and mounted in Canada balsam at the time it was obtained."

SEX OF EGGS.

M. GENIN has addressed the Académie des Sciences on the subject of "The Sex of Eggs." He affirms that he is now able, after having studied the subject for upwards of three years, to state with assurance that all eggs containing the germ of males have wrinkles on their smaller ends, while female eggs are smooth at the extremities.

THE INSANE DESTRUCTION OF SMALL BIRDS.

THE black cap and white throat are being rapidly exterminated in the south of England. Some of the notes of the black cap are superior to those of the nightingale. The chief food of the British song birds are the leaf rolling caterpillar, the green oak moth, the grub of the cabbage butterfly, the meal worm, and all kinds of larvæ. If a little overripe fruit was left on bushes and trees these birds would never touch the sound fruit. Both the black cap and white throat are very fond of the overripe raspberry on account of the white maggot it contains.

In this district (says the *Stamford Mercury*) unemployed young labourers and itinerants are turning their attention to a new mode of obtaining a livelihood. Some of these men have appeared the last two or three market-days at Spalding and Holbeach with hundreds of linnets, finches, sparrows, and other small birds (which they have poisoned), strung round them like beads, as trophies, and an advertisement of their odious calling. Leaving out of the question the fact ascertained by the scientific researches of nearly all the civilized countries of the world, that this mode of interfering with the balance of creation is followed by worse and unconquerable evils in the shape of insects, is it not a matter for

serious consideration that the safety of the community should be jeopardized by such a system? The poisons used for the purpose are the instruments with which revenge or malignity often accomplishes its detestable purpose—*i.e.*, arsenic, strychnine, and phosphorus.

The rookery of Stanway Hall, in Essex, has fared this year the same as that of Rushall Hall. While a Commission has been appointed in France to consider how the evil now so generally complained of can be put down, and while we are transmitting small birds to our colonies, there to pursue a course of usefulness, the farmers' enemy and the wireworms' best friend is traversing the country with poisoned grain and doing his best to secure for us a famine. Around Stanway Hall, the last sowing of wheat has been almost wholly destroyed by the wireworm.

Measures are being adopted throughout France, not only by the authorities, but likewise by the chief landowners, to prevent the destruction of small birds. An association formed for that purpose at St. Cesaire, in the Charente Inférieure, has adopted the following resolutions:—"1. None of us during the year 1862 will either seek to discover birds' nests or to destroy the young birds in whatever place soever they may be, and under no matter what pretext." "2. None of us will pursue any birds after quitting their nests." "3. The nests of sparrows, chaffinches, and linnets may alone be destroyed, these birds being considered mischievous." It was M. Renon, the parish schoolmaster at St. Cesaire, who drew up these resolutions for his pupils, but it is expected that on consideration he will strike out the third resolution, which declares war against sparrows, chaffinches, and linnets, as it is very well known to farmers that they do more service to the crops by destroying the worms than they do injury to fruit-trees.

THE QUEEN BEE.

PROF. LEITCH has announced a new theory on the Queen Bee, a puzzle which has exercised the wits of naturalists and philosophers for many ages. How is a queen bee produced from an egg, which, under ordinary circumstances, would produce a sterile worker? It is commonly supposed that this change is effected by the supply of a peculiar food (a "royal jelly," it has been termed) to the larvæ. Prof. Leitch considers that the change is effected by an increase of the temperature of the cell containing the larvæ intended for the production of a queen bee, and that the object of the isolated position of the royal cell is to admit of it being surrounded by a cluster of bees, who, by their rapidly increased respiration, produce the warmth necessary to accomplish the growth of the queen.—*Athenæum.*

SINGING FISH.

SIR EMERSON TENNENT, in his admirable volume on Ceylon,

made mention of musical sounds said to arise from some of the lakes in the island. In his later published work, *Sketches of the Natural History of Ceylon, &c.*, where he has brought together his zoological and botanical observations, he again refers to the very curious subject of sounds given out by the mollusca, stating that the Indians believed the sounds alluded to were produced by the animal of a shell, and not by any fish, and that those sent to search for the shells brought him specimens of a *Littorina* and *Cerithium*, the latter being *C. palustre.* Sir Emerson Tennent states also, that similar sounds are heard at some places on the western coasts of India, especially in the harbour of Bombay. At Caldera, in Chili, musical cadences are stated to issue from the sea near the landing-place, and the same have been observed at Pascagonda, in the State of Mississippi, and in another river on the northern shore of the Gulf of Mexico. In a letter received lately from J. Hepburn, Esq., San Francisco, who has been travelling in Columbia and Vancouver's Island, the following observation occurs:—"*A fact that* I discovered, which greatly interested me, is the existence in Vancouver's Island of a singing fish (at least shell fish), such as Sir E. Tennent met with in Ceylon. Some of my fishing friends, who had never heard of Sir E. Tennent's book, told me that at a certain arm of the sea running out of Victoria Harbour, they always heard a noise which they compared to the sound of a Chinese kite when flying, a sound well known to all inhabitants of San Francisco, and which is produced by fixing pieces of metal to the kite's tail. I went there and heard it several times, clearly proceeding from the water. The Indians are well acquainted with the noise, and say it proceeds from a stone-fish (shell-fish), and promised to get me some, which, however, they had not done up to the time of my leaving. When I return I will inquire further into it, though I do not know that I can establish anything further than that such an animal exists at the place where the sound is always heard. It is not likely that the Indians and the Cingalese should both attribute the sound to a similar cause, unless there is some foundation for it."

There is no doubt whatever that sounds are produced; and we trust that by calling attention to the facts as stated by Sir E. Tennent and Mr. Hepburn, attention will be directed to the elucidation of the cause.—*Edinburgh New Philos. Journal*, No. 31.

THE SALMON AND THE HERRING.

At the late meeting of the British Association Dr. John Davy read a paper "On the Scientific Cultivation of Salmon Fisheries," by Thomas Ashworth, of Cheadle. The main objects of this paper were to show the great value of salmon fisheries, how they have been neglected in England, and how they might be improved. The produce of the English fisheries has fallen so low that it has been estimated not to exceed 10,000*l.* per annum, and this including the fisheries of Wales, while the

money value of the Irish, according to the reports of the Commissioners of Fisheries, is not less than 300,000*l.* yearly; one fishery in Scotland, that of the Duke of Richmond in the Spey, is said to return to his Grace 12,000*l.* annually. The author, in illustration of what may be accomplished for the improvement of salmon rivers, describes what has been done at his fishery in Galway, and the results. In the short space of ten years, the river has been rendered ten times more productive. During the present season, as many as 3000 salmon have been taken with the rod. This great improvement has been chiefly owing to the great care taken in preserving the streams during the breeding season, at an expenditure of 500*l.*, and by introducing young salmon, artificially bred, into streams fitted for them, but from which the fish had before been excluded owing to impediments preventing access from the sea. These impediments have either been removed or avoided by means of ladders so constructed as to render the passage to and from the sea easy. A striking example is given by him of a river in Ireland converted into an excellent salmon river by means of ladders. This river is in County Sligo, the property of Mr. Edward Cooper. The ladders are over a fall of about 40 feet. So productive has this river, before barren, become, that in July last, as many as 1000 salmon were captured in one week.

The President of the Section (Professor Huxley) made some remarks upon the natural history of the Herring, and called upon

Mr. J. M. Mitchell of Mayville, who read a paper "On the Food of the Herring," in continuation of observations communicated to the Association at Oxford and Manchester. Mr. Mitchell contended that the herring does not confine itself to one species of food, but that it feeds upon crustacea, the young of other fishes, its own young, ovæ, worms, and flies.

SALMON FISHERIES, 1862.

On the Severn, the principal salmon river in England, the fishing was at first unsuccessful, owing to the flooded state of the river; but some fine fish of 20 lb. to 25 lb. weight were taken near Worcester. At Lincombe Weir, on the Severn, a splendid fish was taken—the largest ever remembered to have been captured in the Severn; it weighed 45 lb., and was sold by the fortunate captors (four fishermen working on the river) to Earl Dudley, by whom it was forwarded to Lord Palmerston as a noble specimen of the produce of the Severn.

Sir William Jardine, F.R.S., the eminent naturalist, one of the Commissioners appointed in 1861 to inquire into the Salmon Fisheries of England and Wales, has published a very interesting abstract of the bulky report of the Commissioners in the *Edinburgh Philosophical Journal.* After a few prefatory remarks, he condenses the information which he and his associates obtained in their journey, dwelling especially on the Severn and the Wye, and

he points out what appears as great ingenuity shown in nullifying the advantages which have been so bountifully afforded us in our rivers as sources of nutritious food.

CULTIVATION OF OYSTERS.

M. COSTE has communicated a paper to the French Academy of Sciences on the progress of his Artificial Oyster-beds on the western coast of France. Several thousands of the inhabitants of the island of Ré have been for the last four years engaged in cleansing their muddy coast of the sediments which prevented oysters from congregating there, and as the work advances the seed wafted over from Nieulle and other oyster localities settles in the new beds, and, added to that transplanted, peoples the coast, so that 72,000,000 of oysters, from one to four years old, and nearly all marketable, is the lowest average per annum registered by the local administration, representing at the rate of from 25 to 30 francs per thousand, which is the current price in the locality, a sum of about two millions of francs, the produce of an extremely limited surface. That the waves or currents carry the seed of oysters is a well-known fact, since the walls of sluices newly erected are often covered with them. In the island of Ré the existence of the oyster-beds, however, no longer depends upon this contingency, they being now in a state of permanent self-reproduction. The distinction of oyster-beds into those of collection and those of reproduction is quite unnecessary, since the property of reproduction belongs to them all. In some localities it is sufficient to prepare the emerging banks for collection to see them soon covered with seed ; but in other places nothing would be obtained without transplanting proper subjects, an operation which by no means impairs their reproductive qualities. The concession of emerging banks is anxiously applied for by the inhabitants of the coast, the more so as improvements in the working of this branch of trade are of daily occurrence. Thus, Dr. Kemmerer, of Ré, covers a number of tiles with a coating of a kind of mastick, brittle enough to enable him to detach the small oysters from it. When this coating is well covered with seed, he gets it off all in one piece, which he carries to the place where the seed is to grow. The same tile he coats a second time, and so on, as long as the seed will deposit upon it. In short, wherever the violence of the currents and the instability of the bottom do not present irresistible obstacles, the cultivation of oysters has become a lucrative business.

FREEDOM OF FISHERIES.

M. COSTE has sent in a communication to the French Academy of Sciences on the Freedom of the Sea in connexion with the Fishing Trade. The law interdicts fishing all along the coast of France at certain times and in certain seasons, instead of only limiting the

prohibition to those districts where the new generations require to be protected. M. Coste shows that the seacoasts may be so cultivated as to render such injurious precautions unnecessary. Fish may either be reared in the open sea or in large tanks, and these two methods are productive of different effects. The turbot, for instance, will increase in length when left in a state of liberty; it will, on the contrary, grow thicker if confined within a tank, just as oxen and sheep grow fatter in stables than in the open air. Now, if the various species of fish generally prepared for food really approach the coast, and remain near it during their earliest age, there will be no need of such costly precautions for watching the coast as are now employed by the State. And this, M. Coste tells us, is exactly the case. About the month of April certain parts of the coast, and always the same, are visited by the small fry in enormous shoals, containing every variety except the ray, which only lays one egg at a time, like the hen, and at different places. To give an idea of the richness of these vivaria, M. Coste describes what he has seen at St. Vaast, where, along an extent of coast of at least twenty-five miles, the small fry congregate during the summer season in such profusion, that, in fishing for prawns, upwards of two hundred millions of small turbots, soles, &c., are destroyed in the course of a season — enough to stock the whole British Channel with the choicest fish. At the approach of the cold season these agglomerations are dispersed, and the young fish seek the depths, where the temperature is milder. Hence it appears that the centres where the new generations assemble are near the coast, and that to protect them there is no need of preventing fishermen from following their calling in the open sea, it being only necessary to protect the coast.—*Galignani's Messenger.*

SPONGES.

M. Lamiral, who has been sent on a scientific mission for the purpose of collecting Sponges, in order afterwards to transport them to the coast of Algeria, where endeavours are to be made to acclimatize them, will commence his operations on the coast of Syria. The sponges will have to be taken up together with the fragments of rock to which they are attached; to effect this, M. Lamiral is provided with a submarine boat of his own invention. This apparatus is also to be applied to the fishing of the pearl oyster in the Indian waters, and its subsequent introduction into the Mediterranean, as our readers know. Another bivalve will also form the subject of M. Lamiral's experiments — viz., the byssus, which is covered with a thick beard, about eight inches in length. This beard is composed of silky airs, which were woven by the ancient Egyptians into precious stuffs, and then exported to Tyre, where they received the purple dye for which that place was so celebrated. Even now the Sicilians and Calabrese manufacture silky tissues with this substance, which is of a yellowish-brown colour, with a greenish shade.

IMPORTANCE OF ANIMALCULES.

M. Pasteur, speaking of the wonderful power possessed by the minute plants, mycoderms, in promoting acetic fermentation, says, in conclusion:—"If microscopic beings were to disappear from the earth, the surface of the globe would be incumbered with dead organic matter. It is these who give to oxygen its consuming power. Without them life would become impossible, for death would be incomplete. After death life reappears in a new form, and with new properties. The widely-spread germs of microscopic beings begin their evolutions, and by their aid oxygen is fixed in enormous masses in the organic substances which these beings have invaded, and, little by little, effects their perfect combustion." The memoir, giving details of the experiments of M. Pasteur, will be found in the *Comptes Rendus*.

CROCODILES.

Dr. Gray has read to the British Association a paper "On the Change of the Form of the Head of Crocodiles; and on the Crocodiles of India and Africa." Dr. Gray stated that the crocodile, when first hatched, has the front of the face short and rounded, even in those that have an elongated beak in the adult state. The nose of the different species lengthens and gradually assumes the form which is the character of the kind; and it is at this age that the peculiar forms of the different kinds are best examined and compared. After the animal has assumed its adult size, the bones of the head dilate on the side, and the forehead and nose become more swollen. The change of form thus produced is so great, that some naturalists have regarded them as distinct species. This dilatation of the sides and increase in thickness of the bones of the head are doubtless produced to support the large teeth which are developed as these animals attain their adult age. The author observed, that this was a good instance, as showing the necessity of studying all kinds of animals in all their stages of growth, and under different circumstances. He stated that no species could be said to have been properly observed until all these circumstances had been examined and noted; and that though the notice of a single individual or state of an animal was useful, it could only be regarded as a sign-post, indicating the existence of an animal which required further study and examination.

Dr. Gray then proceeded to speak of the African crocodile. He observed, that Adanson mentioned three crocodiles as found in the Senegal. Cuvier, in his monograph, thought that Adanson had made some mistake, and makes some very severe remarks on the inaccuracies of travellers; but more recent researches had shown that in this case the traveller was correct, and the philosopher at fault. Adanson mentions the green and the black crocodile and the gavial of Senegal. There can be no doubt, from the specimens which are in the British Museum from West Africa, that Cuvier was right in regarding the green crocodile as the crocodile also

field, has made the first trial of the ailanthus worm in England, and has succeeded with it, has given all requisite information for those who in this country are disposed to undertake this new industry, concerning which she is warranted in expressing the hope that it may be destined to prove a fresh source of wealth for this country, as it already is for France.

Mr. Ruskin writes from Geneva as follows in favour of the silkworm of the oak :—A day or two ago a physician of European reputation, Dr. L. A. Gosse, was speaking to me of the experiments recently made in France in its acclimatization. He stated to me that the only real difficulty was temporary—namely, in the importation of the eggs, which are prematurely hatched as they are brought through warm latitudes. A few only have reached Europe, and their multiplication is slow, but once let them be obtained in quantity and the stripping of an oak coppice is both robe and revenue. The silk is stronger than that of the mulberry-tree, and the stuff woven of it more healthy than cotton stuffs for the wearer; it also wears twice as long.

As great disease has recently occurred among the silkworms in France, it became important to introduce a new species. The silk culture in France alone yields 300,000,000 francs per annum. The silkworm ordinarily produces about 150,000,000 francs of raw silk, besides which about 60,000,000 francs value have been imported. The silk, after being manufactured at Lyons, Nismes, St. Etienne, &c., acquires a value of more than 310,000,000 of francs. The disease of the silkworm becomes, therefore, to these manufacturing centres, a perfect scourge. The Society of Acclimation in France endeavoured to examine into the cause of the disease among the silkworms. It appears that the disease is caused principally by a diseased state of the mulberry-trees, on the leaves of which the silkworms are fed. The insect disease was cured by placing the infected eggs for some time in a box containing a little spirits of turpentine. This treatment, however, does not prevent the reappearance of the disease in the worms when they are fed upon the leaves of the diseased mulberry-trees.—*Edinburgh New Philos. Journal, No.* 32.

The Société d'Acclimatation has received a letter from M. G. Simon, now in China, in which he gives the following account of a curious breed of silkworms inhabiting the province of Che-Kiang, and especially the district adjoining the town of Hang-Chow.

This silkworm is much smaller than the common one, but does not differ from it in other respects. It has the same number of legs, the same spots, and is of the same colour; but its habits are much more independent. The butterfly deposits its eggs anywhere, but chiefly on the branches and within the interstices of the bark of the mulberry-tree, on the leaves of which it generally feeds. The inhabitants do not attempt to collect these eggs. Early in August—that is, two months after the ordinary silkworm has performed its various evolutions—myriads of minute worms suddenly make their appearance on the bark of the mulberry-tree, and invade the new crop of leaves which has made its appearance. They grow fast, the gardeners doing nothing more than protect them from the birds by casting nets over the trees, which are all dwarfed. As these silkworms make their appearance unexpectedly, as

it were, and yield a second crop of silk without any trouble, they are called Tien-tze, or children of heaven, by the people. The warmer the winter has been, the greater is the number of these worms; they bear a temperature of 25 deg. Fahr. very well. Their existence as silkworms does not exceed three weeks; at the end of that time they congregate under the leaves, which they bind together, and then spin their cocoons, an operation which takes them three days. A week later their metamorphosis is complete—the cocoon is perforated, and the butterfly comes out. The cocoons are extremely small, but from 15 to 18 kilogrammes of them yield one of silk; they are wound off in hot water like the others. The pekul (60½ kilogrammes) of cocoons fetches from 9000 to 10,000 sapecks (36f. to 40f.) in the market. The Chinese do not use this silk alone, but mix it with the other.

BOTANY.

VEGETABLE PHYSIOLOGY.

M. Georges Ville is prosecuting his interesting researches, and has just read before the French Academy of Sciences a memoir on "the Comparative Importance of the Agents of Vegetable Production," in which he deals with the question, "If urea has a favourable action upon vegetation, why does its compound ethylurea remain inactive?" The formulæ by which he supports his view of the importance of the neutrality of this latter substance in relation to the action of ammonia, &c., will interest students in agricultural chemistry, the mysteries of which appear to be gradually opening to philosophical research.

THE DISTRIBUTION OF ARCTIC PLANTS.

Dr. Joseph Hooker, of the Kew Botanic Gardens, has published a memoir on this subject in the Linnean Society's *Transactions*, which will be fully appreciated by geographical botanists. The Arctic flora forms a circumpolar belt of 10 to 14 deg. There is no abrupt break or chain in the vegetation anywhere along this belt except in the meridian of Baffin's Bay, where the opposite shores present a sudden change from an almost purely European flora on the east coast to one with a large admixture of American plants on the west. The number of flowering plants is estimated at 762; of cryptogamia at 925; total, 1687. Regarded as a whole, Dr. Hooker considers the Arctic flora to be decidedly Scandinavian; for Lapland, though a very small tract, contains by far the richest Arctic flora, amounting to three-fourths of the whole. Of the five districts into which Dr. Hooker divides the Arctic belt, Greenland is the most remarkable; since, although so favourably situated for harbouring an Arcto-American vegetation, it presents but little trace thereof, and has an almost absolute identity with that of Europe. This, he considers, cannot be accounted for except by admitting Mr. Darwin's hypothesis of the great geological antiquity of the Scandinavian flora; its subsequent migration southward in every latitude during the glacial period, and even across the tropics into the south temperate zone; and

the ascent of the mountains of the warmer zone by many species at the commencement of the warmth of the present epoch. The memoir is accompanied by a map and elaborate classified tables.

NEW AUSTRALIAN PLANTS.

MR. GREGORY, the explorer of North-western Australia, had visited Melbourne, with several new plants and objects of interest which he had discovered. One was a new species of gourd, found at Nickleby, in lat. 20 S., long. 117 E.; also a plant believed to be entirely new, the fruit of which, when fresh gathered, has a very strong smell resembling garlic; likewise a new species of palm, some fine kinds of beans, and several handsome pearls.

THE POMEGRANATE-TREE.

DR. ODEPH, perceiving that the fresh bark of the root of the Pomegranate-tree is an infinitely more powerful remedy for the tape-worm than the dry bark, but that, on the other hand, the only way of procuring it is to buy a small plant of a gardener, which is often beyond the reach of the patient's means, has prepared the aqueous extract of the fresh bark, which will keep a long time, and is equally efficacious, and less costly than the unprepared substance.

THE ILLOOPAY PLANT.

MR. HAYES has sent in a paper to the Société d'Acclimatation recommending the introduction of the Illoopay Plant (*Bassia longifolia* and *latifolia*) into Algeria. This plant, well known in the Presidencies of Madras and Bombay under the name of *Mohee*, and in Bengal under that of *Moolah*, is remarkable for the aromatic alcohol obtained from its blossoms by fermentation. The seed contains about 30 per cent. of its weight of a kind of oil, which is always in a solid state, and may be advantageously applied to the manufacture of candles and soap. The tree grows wild in India, constituting about one-sixth of the forests which lie in a line between Calcutta and Bombay. Its wood is as hard as teak, but not quite so durable.

NUMBER OF SEEDS PRODUCED BY ORCHIDS.

DARWIN estimated the seeds contained in four capsules of *Cephalanthera grandiflora* at 24,000, and in thirty capsules on a plant of *Orchis maculata* at 186,300. An acre of land would hold 174,240 plants of *Orchis maculata*, each having a space of six inches square, which is rather closer than they would flourish together; so that allowing 12,000 bad seeds, an acre would be thickly clothed by the progeny of a single plant. At the same rate of increase, the grandchildren would cover a space slightly exceeding the Island of Anglesea; and the great-grandchildren of

a single plant would nearly (in the proportion of 47 to 50) clothe with one uniform green carpet the entire surface of the land throughout the globe.—*Darwin on Orchids.*

A SINGULAR DEPOSIT IN TEAK-WOOD

WAS lately brought under the notice of the Chemical Society by Mr. F. A. Abel (chief of the Chemical Department at Woolwich Arsenal). A white substance was found intersecting specimens of the wood in the form of layers, converging towards the centre. The layers, which are sometimes soft and pulverulent, and sometimes so hard as to blunt the cutting edges of the saws employed, are often several feet in length, six or eight inches in breadth, and from one to three eighths of an inch in thickness. They have evidently been deposited in cracks in the living trees. Cavities occasioned by knots in the wood are frequently filled by the same white deposits, as also extensive perforations made by a caterpillar. The deposit, occasionally of a striated crystalline structure, gave the following results on analysis:—Lime, 34·04; magnesia, 1·86; ammonia, 1·12; phosphoric acid, 43·35; carbonic acid, a trace; and 19·54 of water; with a minute proportion of organic matter.

THE TALLOW-TREE IN ALGERIA.

THIS remarkable tree, a native of China, and called by botanists *Croton sebiferum* or *Stillingia sebifera,* has now been successfully acclimatized in Algeria, through the exertions of the French Government. Its cultivation would diminish the cost of candles. A tree ten years old, according to *Galignani,* yields from one to two kilogrammes of tallow: fifteen years later it will yield from three to four. It requires no care or watering; and may be planted on the roadside. In the island of Chusan large quantities of oil and tallow are extracted from its fruit. In hot weather the candles made with the tallow are apt to become soft, and even liquid; but to guard against this inconvenience they are dipped into wax.

THE WAX-TREE OF JAPAN.

ON this remarkable plant, the *Rhus succedanea* of botanists, the *Bulletin de la Société d'Acclimatation* publishes an interesting paper by M. Eugène Simon, now at Nagasaki. The vegetable Wax of Japan is one of the chief articles which that country exports. It is not exactly of the same nature as common wax, since it melts in summer at the common temperature; but this inconvenience is obviated in Japan by protecting the candles made with this wax by a coating of bees'-wax. It appears that in England a process has been discovered for increasing its consistency, since the demand for the article from that quarter has considerably increased of late. The tree itself might be easily acclimatized in the southern parts

of France. It thrives on mountains and on stony and barren ground, unfit for other agricultural purposes. M. Simon has sent over about 20 kilogrammes of its seed for trial. The young trees are planted in Japan along the highways, when they are two years old, leaving a distance of about three feet between the stems ; but if planted in squares, the distance must be double. The trees are kept low by lopping, and trimmed in the shape of pyramids. In the fifth year after planting, each tree yields on an average 4 lb. of seeds ; in the eighth year, 6 lb. ; in the 10th, 18 lb. ; in the 12th, 40 lb. ; in the 15th, 60 lb. ; in the 18th year the tree enters upon its decline ; 400 lb. of seed yield 100 lb. of wax. At present 200 lb. of this wax are sold in London at the price of 5*l.* ; so that a plantation of 10,000 trees in their prime may produce 4000*l.* The seed is gathered towards the end of autumn, threshed, and then left to dry for a fortnight, after which it is slightly roasted. It is next crushed under a millstone, and the produce exposed to the heat of steam in canvas bags ; the wax is then obtained by the action of a screw press. This wax is of the third or lowest quality ; to bleach it, it is rasped, rinsed in water, and then exposed to the action of the sun and dew for three days. A still higher quality is obtained by repeating this operation.—*Illustrated London News.*

JAPANESE PLANTS.

THE *Bulletin de la Société d'Acclimatation* contains the second part of a letter from M. Eugène Simon, writing from Japan, recommending the cultivation of the hemp-palm (*Chamærops excelsa*), brought over into Europe about thirty years ago by Dr. Sieboldt, but hitherto confined to botanical gardens. This species of palm-tree would thrive very well in France, since it will bear a temperature of 10 degrees Fahrenheit. It requires no particular care ; the stalk of each leaf is covered with filaments of various fineness ; the coarsest are used for ropes, the finer sort for nets. Every second year the leaves are cut off close to the trunk, except a few which are left on the top ; the filaments are separated and packed into bales of 26 kilogrammes each. The price of this commodity varies from 50f. to 70f. per 100 kilogrammes. Each tree will yield from four to five kilogrammes. Another plant mentioned by M. Simon is the *soja*, a kind of bean, used in Japan for a condiment, which is manufactured on a large scale at Nagasaki and other places, and is sold at the rate of about 17f. per jar, weighing 214½ kilogrammes. To prepare this condiment the beans are boiled, and then mixed with roasted barley. When the dough thus obtained has become perfectly uniform by stirring, it is put into moulds 1½ inch in height, and 18 inches by 8 at the base. The cakes so made are left to ferment for a week in a close room, when they acquire a uniform golden hue. They are then thrown into large vats, and lime water is added in the proportion of two kilogrammes for every kilogramme of cakes. After stirring a good deal, the vats are then left to themselves for at least a twelvemonth ;

the substance contained in them is then put into canvas bags, and subjected to the action of a press. A syrupy liquid oozes out, which is *soja* of the first quality; of the residue an inferior quality is made for the poor. It is used in almost every Japanese dish, is very savoury, and particularly well adapted to fish.—*Galignani's Messenger.*

THE CANDLEBERRY MYRTLE.

MYRICA CERIFERA is the subject of a paper by Mr. G. E. Moore, in Silliman's *American Journal of Science.* He states that it is a hardy plant, thriving best on poor soils near the sea, producing abundant crops. Its fruit yields a wax, which, under the names of myrtle-wax, candleberry-wax, and barberry-tallow, has been for some time an article of commerce to a limited extent in the United States. The wax occurs as a white incrustation on the small globular nuts of the plant. To obtain it pure, the berries are enclosed in bags of coarse cloth and immersed in boiling water until the fused wax collects on the surface. It is then poured off into pans, in which it solidifies on cooling, when it is fit for commerce. Its chemical composition was found by Lewy to be—carbon, 74; hydrogen, 12; and oxygen, 14. It is found to be the most accessible source known for pure palmitin and palmitic acid. In illuminating power it is scarcely inferior to the best bees'-wax, whilst it can be produced at less than one-fourth the cost. It also forms an excellent soap. As a substitute for bees'-wax Mr. Moore considers that the myrica wax has not received due attention, and says that there is no reason why increased cultivation should not constitute this wax as an important article of commerce. Further details will be found in the *Journal.*

SILK CULTURE AT PARIS.

THE Marquis de Fournes has sent to the Zoological Garden in the Bois de Boulogne, at Paris, some feet of the Georgian long silk cotton plant as a specimen of what he has produced after having cultivated it for two years on his property of Remoulin, on the banks of the Gardon, near the bridge of the Gard. The Marquis de Fournes, being of opinion that there is a great similarity between the climate and the soil of Algeria and a part of Languedoc and Provence, considered that it would not be impossible to introduce the cultivation of cotton into one of these provinces. He commenced a plantation of a few perches, which he has since increased to eight acres with complete success. The cotton planted by the Marquis is of the Georgian species, called "long silk," from the length, fineness, and elasticity of the fibre, which render it suitable for the most delicate operations, such as the manufacture of the finest muslins and the most delicate lace. The cotton produced by the Marquis de Fournes was spun by M.

Schlumberger, of Guebwiller, and was classed among the finest. It sold at five and six francs the kilogramme. Some specimens of this French cotton were admitted to the Exhibition in London. The Minister of Commerce has taken the greatest interest in the Marquis de Fournes's experiments. The plants which are exhibited in the Zoological Garden in the Bois de Boulogne are the finest which have yet been seen in Europe. The *Napoléonien*, of Avignon, states that at the suggestion of the Agricultural Society of Avignon, experiments for raising cotton on a large scale are about to be made in the madder lands.

BARK AND QUININE.

THE supply of Quinine has been for some time past a subject of serious anxiety. There is, perhaps, no drug which is more valuable to man than the febrifugal alkaloid which is extracted from the cinchona trees of South America: yet such has been the improvidence in gathering their crop of bark, that, as the high price of the drug sufficiently testifies, we were in danger of seeing its supply reduced to a vanishing point. It appears, that under these circumstances, we have been looking to India, where the cinchona plants are now acclimatized, to sustain our supply of bark if that of Peru should fail, and Mr. Markham,* who has been the principal agent in the experiment, has published an elaborate narrative of his labours. In this narrative we have the latest intelligence on the subject of quinine. Apart from its importance as an article of commerce and a medical specific, all the varieties of the cinchona are here described for the botanist, and some new information on a subject on which our encyclopædias confess that we are still much in the dark, has been collected for the general reader.

Under apprehensions of losing the supply of bark altogether, it appears that the Dutch were the first to attempt its acclimatization in Java; but from insufficient botanical knowledge of the varieties of the cinchona, and from other impediments, their endeavours were only partially successful. The introduction of the cinchona plant into India was next recommended by Dr. Royle, so far back as 1839, and it was officially urged upon the Governor-General in 1852. In 1859, the services of the author were engaged to superintend the collection of plants and seeds in South America and their transfer to India, and the necessary arrangements were authorized by Lord Stanley, then Secretary of State. Mr. Markham had various assistants, but he himself undertook to explore the forests either of Caravaya or Bolivia, and to collect the *C. calisaya* and other important species of that more distant region, and his labours and observations in the course of this quest constitute the principal substance of the volume before us. He has amplified this by some descriptions of Peruvian remains

* *Travels in Peru and India, while superintending the Collection of Cinchona Plants and Seeds in South America, and their Introduction into India.* By Clements R. Markham, &c. Murray, 1862.

and scenery, illustrated by a few woodcuts, and an account of the Peruvian Indians in their latter days, which might serve as a supplementary chapter to Mr. Helps's *Spanish Conquest in America*. More pertinent to his immediate subject is his account of the impediments he himself encountered to his removal of the plants he had collected, through the jealousy of the *Juntas Municipales*, which his operations had excited. He was, in fact, obliged to dodge the authorities before he could get his stores to the coast and prepare them for transplantation to the Neilgherry hills.

In pages 486-7, &c., the reader will find the more important announcement of the comparative success of the culture of cinchona in the Indian peninsula. The mistakes of the Dutch authorities have, it seems, been avoided, and there is now a prospect that in various districts of India, and even in Ceylon, cinchona will be reared and become an important item in the table of our Indian exports. In India itself an ample supply of this drug will be an immense boon and benefit. Since quinine has been extensively used among our troops there, there has been a steady diminution in the per centage of mortality. Whereas in 1830 the average per centage of deaths to cases of fever treated was 3·66, in 1856 it was only one per cent. in a body of 18,000 men scattered from Peshawur to Pegu. The importance to ourselves is hardly less, for by this means we shall be spared a contingency which was more imminent than we supposed, and instead of a dwindling supply of this febrifugal specific, we shall probably soon have the drug so abundant, that its price will be sensibly diminished. At least, we shall have reason to be thankful if the supply is rendered secure, and no fevered Briton is deprived of a remedy to the want of which, in the opinion of Mr. Markham, we may ascribe the deaths of Oliver Cromwell and Alexander the Great.—*Abridged from the Times.*

EXPERIMENT ON HEATING EARTH FOR THE GROWTH OF TROPICAL PLANTS IN THE OPEN AIR.

In the *Horticultural Society's Journal* is an account of this experiment by Captain Trevor Clarke. He had a rectangular cutting made into the ground, 21 ft. long and 9 ft. broad, and sufficiently deep to admit of arrangements for heating the chamber by means of pipes connected with a small boiler. Over the chamber a compact slate flooring was formed. This was covered with fresh turf as a bottom, and on this again was made a bed, consisting of fresh strong loam and old hot-bed manure, sufficiently deep to admit the balls of plants grown in half-bushel pots. The boiler was arranged so that the fire could "burn anything." Captain Clarke's results are very interesting. Although his arrangements were carried out very roughly in June and July last, yet many tropical plants grew and flourished in the open air. Sugar-canes took to the ground at once. The purple Palma Christi produced a grand effect, and the Arundo Donax variegata was the finest

thing in the collection. Some plants, however, grew very sluggishly, from the destructive effect of strong winds upon the foliage, and so many plants of different constitution, habits, and strength.

HORTICULTURAL EMPLOYMENT OF CHLORIDE OF LIME.

THE eminent chemist, Professor E. Kopff, states, that if a little Chloride of Lime be sprinkled on a plank in stables, all species of flies, especially stinging ones, will be driven away; and that if leguminous plants be sprinkled with a weak solution of the same salt, they will be preserved from the ravages of insects, snails, &c. The same beneficial effect may be produced on fruit-trees by making a paste formed of one part of chloride of lime in powder and half a part of some fatty substance, and forming a narrow circle of the paste round the tree.

TRANSMUTATION OF "SPECIES" IN THE VEGETABLE WORLD.

IT has been repeatedly asserted that oats have been converted into rye, barley, and even wheat; but the "fact" has been always scoffed out of countenance, because it was inconsistent with preconceived theories. Now, however, there would appear to be no doubt about it. The *Mark-lane Express* vouches for the respectability of a gentleman who states that he carefully planted some picked oat grains in his garden in June; and as the tillers sprang up to about a foot in height, he cut them down to within an inch of the root. This process was three times repeated that year, and some of the roots died; but others survived; and next year they yielded—not oats, but perfect barley, rather thin, but by no means of a bad type. This barley, in the following spring, yielded a good return of better barley, approved by the malster; and of the produce of subsequent years the Editor says he has seen a sample. It is remarkable that the grower did not look for barley, but rye, which he had been told had thus been obtained. The Editor is of opinion that oats are a "spurt" or sport from other grain—not *vice versâ;* as wheat and barley have been known for 4000 years, but not oats.

It is said that the transmutation of oats into barley is by no means infrequent in Norway and Sweden, which, by the way, geologists have found to be a notable centre of plant distribution.

A letter from Mr. William Cowper, of Wappenham, near Towcester, appears in the *Berkshire Chronicle*, stating that he has for ten years grown both wheat and barley from Dutch oats. Black oats, he adds, will produce rye in the same way.

If any one imagines, however, that when such facts can no longer be denied, we will be any nearer to an admission that one species of plant can be transmuted into another species, he will probably be mistaken; for when the fact can be no longer resisted, it will only be seized hold of as proof positive that oats, rye, barley, and wheat are *not* distinct species at all; so that the transmutation of species will be as far off as ever, and thus may well be deemed impossible.—*Builder*.

Geology and Mineralogy.

VARIATIONS OF SURFACE.

MR. BEETE JUKES, President of the Geological Section of the British Association, at their late meeting, inquired how the Variations of the Surface called mountains, hills, cliffs, glens, valleys, and plains were formed. He took first the formation of great plains, and showed that although some were formed as plains on horizontal beds, few even of these retained the original surface of the position, but had more or less a denuded surface. Many equally level plains were low and level, because mountainous masses of rock, often greatly disturbed and contorted, had been removed from above the present surface. The central plain of Ireland, and other plains in the British Islands, were formed in this way. All mountains, except volcanoes or "hills of ejection," were either "hills of circumdenudation," formed by the wearing down and removal of the rocks formerly around them, or "hills of uptilting." In the latter, the lowest rocks appeared in the central parts of the chain, often reared into the highest peaks; and these central beds dip on either hand under higher and higher groups, which come in as we recede from the axis of the chain. The beds have been raised by mechanical force acting from below; but this, however it had tilted or bent them, could not remove them, so that the successive exposure of lower and lower beds as we approach the axis of the chain, must be owing to the external erosion of moving water. These "hills of uptilting," then, were hills not in consequence, but in spite of denudation, and would have been many times loftier had it not been for the erosive action. Mr. Jukes declared his belief that all the striking external features were the result of the direct action of the external forces called the "weather," and were not caused by any direct action of the internal forces, which could only reach the surface through the thickness of the crust. He then examined these forces of erosion; and while he attributed to marine action all the greater and more general features, the great plains, the long escarpments, and the general outline of the mountains, he believed that the valleys which traversed the plains, the gullies that furrowed the sides of the hills, and the glens and ravines on the flanks of the mountains, were all due to the action of the ice or water which fell on them from the atmosphere. He did not give these views as altogether original, but mentioned M. Charpentier and Mr. Dana as having long ago applied them to the Pyrenees and to the Blue Mountains of New South Wales; but having been long sceptical as to their reality, he now wished to record his conviction of their truth. Mr. Prestwich, Prof. Ramsay, and himself, while pursuing different lines of investigation, had all been simultaneously compelled to appeal to sub-aerial action as the only method of explaining the phenomena they had met with; and Dr. Tyndall had since fallen into the same line of march.

GEOLOGICAL SURVEY OF INDIA.

THIS Survey is going on with vigour, under the able superintendence of Dr. Oldham. By the last Annual Report it appears that the following districts have been surveyed more or less completely:—In Bengal, the country adjoining the Kurruckpore Hills in Monghyr, and extending across the district of Behar, so far on the parallel of Gya; also the coal-fields in the south, from the limits of the Burdwan district to the Ghats at Dhurwa, and southward to Hazaribagh; in Central India, the Rewah district, in the southern part of which coal exists; in the North-western Provinces, the Sewalek and sub-Himalayan rocks of and near Kangra; in Madras, the districts of Cuddapah and Kurnool; in Pegu and Tenasserim, the district of Henzada, which contains some petroleum wells. The publication of the Memoirs of the Geological Survey, with excellent palæontological plates, is an important step in geology. This valuable work reflects the highest credit on Dr. Oldham and the officers of the Survey, and bids fair to develop the mineral treasures of our Indian possessions. The formation of a geological museum and library is also a subject of congratulation.

GEOLOGY OF SHROPSHIRE.

AT a late meeting of the Geological Society was read a paper on the Carboniferous Limestone of Oreton and Farlow, Clee Hills, Shropshire, by Professor Morris and Mr. G. E. Roberts. In consequence of the opening of new quarries and the cutting of a roadway laying open thin beds of limestone and sandstone, the authors were enabled to add somewhat to the description of the locality given in the "Silurian System." In describing the physical condition of the locality, mention was made of the Mole River, which, losing itself at the west end of the ridge, takes a subterranean course, nearly parallel with its axis, and reappears at its lower end a mile distant. An interesting account was given of an accidental accumulation in the hollow of its inlet of a body of water estimated at 1,635,000 cubic feet, the whole of which was carried away in forty-eight hours by the sudden clearance of the channel. Amongst the fossils discovered was a specimen of Pterychthys macrocephalus, of which a descriptive note by Sir P. de M. Grey-Egerton, Bart., was read. The richness of the overlying limestone in palatal teeth was shown in a fine series of examples.

THE CAMBRIAN, HURONIAN, AND LAURENTIAN FORMATIONS

ARE the oldest at present known to geologists. In a paper read to the Geological Society, Dr. J. J. Bigsby gives some observations on them, pointing out the very local distribution of the Cambrian, its mineralogical and stratigraphical character, the scarcity of its fossils, its conformable upward passage into the

Silurian, and its absence in America and Northern Europe. In the second part of his paper Dr. Bigsby described the Huronian of Canada, the Azoic rocks of the southern shores of Lake Huron and Lake Superior, and the second Azoic group of Norway, all of which are considered by Dr. Bigsby to belong to the same period. He then stated that the Huronian formation and its equivalents agree in being unconformable to the Silurian and conformable to the Laurentian, in containing many beds of limestone and a large quantity of copper ores, and in the total absence of fossils; in all of which respects they differ from the Cambrian. He therefore came to the conclusion that the Cambrian and Huronian are distinct formations, and that the latter is very much the older.

GEOLOGY OF IRELAND.

PROFESSOR J. B. JUKES, of the Irish Geological Survey, in the discharge of his duties has been led to consider the probable mode of formation of some of the river valleys in the south of Ireland, and has recently laid before the Geological Society of London some of his observations. After describing the physical structure of that part of the island south of the limestone plain that extends from Dublin to Galway Bay, he proceeds to show that the rivers Shannon, Barrow, Nore, and Suir, after traversing this low ground, escaped to the sea by ravines worn through lofty hills of old red sandstone and lower Silurian rocks. He also instanced the rivers Blackwater, Lee, and Bandon as each suddenly deserting the low longitudinal valleys through which they had run for many miles, and turning at right angles down ravines of old red sandstone, notwithstanding the fact of the longitudinal valleys being continued with no apparent obstruction to the course of the rivers. He showed the connexion of these lateral ravines with the coming of strong brooks from the higher ridges of the north into the longitudinal valleys, and also that these brooks probably produced the ravines, having first begun to erode them over a surface above the present ridges, and before the formation of the longitudinal valleys. He considered the fact proved that the present "form of the ground" in the south of Ireland was produced by atmospheric erosion on dry land; and that the limestone ground was low because the rock had been dissolved chemically as well as eroded mechanically; and that its surface had sunk to a lower level than the other rocks, like that of a glacier melting in its bed. He proposed to extend this explanation generally to all dry land.—*Illustrated London News.*

RAISED BEACH.

A PAPER has been read to the Geological Society, by Mr. W. Carruthers, "On a Section at Junction-road, Leith." The author stated that in the section of clay, sand, and gravel near Leith, described by Mr. Geikie as part of a raised beach elevated since

the period of the Roman occupation, not only have mediæval pottery and tobacco-pipes been found in the pottery-bearing deposit described by Mr. Geikie, but a mediæval jar has been met with in the sand beneath. The so-called "Roman" pottery was stated by the author to be of mediæval age, on the independent authority of Messrs. Birch and Franks, of the British Museum; and he believes that the beds in question are mainly of late and artificial formation; he does not, however, argue from this that there is no evidence of a late upheaval of the central part of Scotland.

LAND ELEVATION OF THE CENTRAL VALLEY OF SCOTLAND.

MR. A. GEIKIE, in a paper read to the Geological Society, after alluding to the position and nature of the raised beach which, at the height of from 20 to 30 feet above the present high-water-mark, fringes the coast-line of Scotland, proceeded to describe the works of art which had been found in it. From their occurrence in beds of elevated silt and sand, containing layers of marine shells, it was evident that the change of level had been effected since the commencement of the human period. The character of the remains likewise proved that the elevation could not be assigned to so ancient a time as the Stone Period of the archæologist. The canoes which had from time to time been exhumed from the upraised deposits of the Clyde at Glasgow clearly showed that, at the time when at least the more finished of them were in use, the natives of this part of Scotland were acquainted with the use of bronze, if not of iron. The remains found in the corresponding beds of the Forth estuary likewise indicated that there had been an upheaval long after the earlier races had settled in the country, and that the movement was subsequent to the employment of iron. From the Firth of Tay similar evidence was adduced to indicate an upheaval possibly as recent as the time of the Roman occupation. The author then cited several antiquaries who from a consideration of the present position of the Roman remains in Scotland had inferred a considerable change in the aspect of the coast-line since the earlier centuries of the Christian era. He pointed out also several circumstances in relation to these Roman relics, which tended to show a change of level, and he referred to the discovery of Roman pottery in a point of the raised beach at Leith. The conclusion to which the evidence led him was that since the first century of our era the central parts of Scotland, from the Clyde to the Forth and the Tay, had risen to a height of from 20 to 25 feet above their present level.

THE LONDON BASIN.

A PAPER has been read to the Geological Society, by Mr. W. Whitaker, of the Geological Survey, Great Britain, "On the Western Extremity of the London Basin; on the Westerly Thinning of the Lower Eocene Beds in that Basin; and on the Greywethers."

In the first part of this paper the author described certain outliers of Tertiary strata in the neighbourhood of Bedwin and Savernake (or Marlborough) Forest, in Wiltshire, where in the course of the Geological Survey of the district he found that both the Woolwich and Reading Beds and the London Clay gradually thinned out westward, until merely 3 or 4 inches of the latter alone remained between the Bagshot Beds and the Chalk. Further eastward these are probably in direct apposition. The superficial loam and clay with unworn flints on the Chalk district along the northern side of the London Basin were then described.

In the second portion of the paper it was shown, both from the published results of Mr. Prestwich's researches and later observations made in the progress of the Geological Survey, that the Thanet Sands thin out westwardly, from a thickness of about 85 feet in the Isle of Thanet, to about 35 feet at London, and to 3 feet at Chobham, disappearing altogether near Epsom. The Woolwich and Reading Beds include the Blackheath Pebble-bed, according to the author: at Herne Bay Mr. Whitaker gives these beds a thickness of about 50 feet, at Croydon 45 feet, at New Cross 54 feet, at London from 40 to 70 feet, at Ealing 60 feet, at Hanwell 75 feet, at Chiswick 90 feet, at Reading about 50 feet, and near Great Bedwin in Wiltshire only 15 feet. The London Clay, with its Basement-bed, is nearly 480 feet thick at Sheppey, 400 feet at London, 370 feet at Reading, 20 to 60 feet near Newbury, only 15 feet near Great Bedwin, and is represented by a few inches of its pebbly basement-bed in Marlborough Forest.

The third part of the paper treated of the Greywether Stones of Wiltshire, which the author believes must have come from the Bagshot Sand, which alone of the Tertiary Beds is present there in sufficient thickness to yield these large and numerous masses of bedded rock.

HUNSTANTON CLIFF, NORFOLK.

A PARTY of geologists, members of the British Association, made an excursion from Cambridge during the late meeting, to visit the curious geological section exposed in the Cliff at Hunstanton, on the coast of Norfolk.

Three strata are to be seen there, the lower being the lower greensand, here of a buff colour; a bright red rock overlying it, which is usually called red chalk, but which the geologists present were inclined to believe represented, or rather, perhaps, replaced, the gault and upper greensand; and over it the true chalk formation. A geologist who accompanied the party gives the following additional details :—

"The attention of the excursionists was first directed by Mr. Vincent, the engineer, to a gravel-pit from which the ballast used

on this part of the new line of railway has been obtained. This gravel was stratified and contained the remains of shell-fish still living on the coast; in some parts of the pit were irregular patches of agnite much decomposed, which has probably been derived from the submarine forest still seen at low water off this coast. The presence of this gravel with its imbedded fossils showed conclusively that the land had risen at least 50 feet at a comparatively recent period. After spending a few minutes on this interesting spot the party walked through the village to examine the real object of their visit, the problematical deposit known to geologists as the red chalk of Norfolk. The cliffs, which rise to the west of the Coastguard station, are composed of the gray or lower chalk; the red chalk, which is about four feet thick, rises beneath and rests on the car stone, the lower green sand or Shanklin sands of geologists. On arriving at a sheltered spot at the base of the headland, Professor Phillips addressed the party, and pointed out the most interesting features in the adjacent section, comparing it with similar ones on the coasts of Norfolk and Lincolnshire. The Professor confined his remarks to the question of the age of the stratum, and endeavoured to account for its red colour. He was inclined to consider the red as only a modification of the lowest beds of chalk, or, at most, the equivalent of the upper greensand. The ferruginous colouring matter he thought was deposited with the sediment, which is now hardened into the bed of red chalk. However, he did not wish to consider either of these questions as settled.

"The Rev. J. Wiltshire, Mr. L. Barrett, and Mr. Woodward expressed their opinion that both the upper greensand and gault were represented by the bed in question."

LANDSLIP AT LYME REGIS.

AN extraordinary Landslip has taken place on the coast between LymeRegis and Charmouth. A man who was close at hand describes the noise as having been "like a thousand thunders." Scarcely ten minutes before the slip took place, a gentleman who owned part of the lost land was standing on the edge of the very highest part of the cliff, expressing his admiration of the magnificent view before him, as, it being clear weather, he could see Portland on the one hand and Start Point on the other. Within a quarter of an hour, the ground on which he stood was strewed in fragments upon the beach, at least 100 yards in perpendicular depth below. The appearance of this landslip is very different from that of the great slip near Axmouth, 1839. In the case of the latter an enormous mass slid bodily into the sea, and was comparatively but little broken. In this slip but a very small part of the detached mass held together. Nearly the whole of the cliff seems to have fallen over, and to have been dashed to atoms. It is difficult to estimate correctly the area of cultivated ground lost; at present the distance from the road to the edge of the cliff is about 80 yards. It

is said, however, that the slip covers nearly 10 acres of ground, and certainly is the largest fall of earth since the great landslip of 1839 referred to above. The beach itself, right down to low-water-mark (and we cannot say how much further), is a chaos of blue lias, mud, and rocks, the latter varying in size from the smallest conceivable fragment to the great mass of many tons weight, and the former in consistency from treacle to butter.

FORMATION OF THE MUD OF THE NILE.

In the *Annales de Chimie* are extracts from a letter to M. Dumas from M. Méhédin, in Egypt, from which we extract a few notes:—In the months of April and May the Kamsin, or wind of the Desert, blows for about fifty days on Egypt. The sand it brings with it darkens the sky and covers the earth with a light layer; while that which falls on the Nile sinks through its weight. In June calm weather returns, and the north wind begins to blow, gradually becoming more powerful. It should last all the summer, as without it life is difficult in Egypt. From July 1 the Nile at Cairo is seen to rise and change in colour from greyish green to brownish yellow, and soon to the colour of yellow ochre. M. Méhédin ascended the Nile in order to observe the agricultural effects of the inundation and collect specimens of the mud. About Sept. 10 the inundation was at its height, and for several days the valley had the appearance of a long strait, dotted with numerous isles. In October the water decidedly began to retire, and layers of mud were deposited on the earth. M. Méhédin was able to obtain specimens of more than five hundred layers of this mud, in chronological order; for, thanks to the regular annual passage of the Kamsin, bringing with it layers of sand, each year is indicated in characters as clear as those which show the age of an oak in a horizontal section. The various specimens of water and mud sent to M. Dumas have been analysed by M. E. Willm. The early deposit gave in 100 parts:—Loss by fire (carbonic acid and organic matters), 6·69; nitrogen, 0·11; silica (quartz and mica), 77·20; alumina and peroxide of iron, 11·15; phosphoric acid, 0·65; lime, 1·90; magnesia, 0·20; soda, 0·30; hydrochloric and other matters not treated (the parts soluble in water), 1·80.—*Illustrated London News.*

PETROLEUM.

Dr. A. Gesner, has stated to the Geological Society that 50,000 gallons of Mineral Oil are daily raised in North America. The oil is said to be derived from Silurian, Devonian, and Carboniferous rocks. In some cases, the oil may have originated during the slow and gradual passage of wood into coal, and in its final transformation into anthracite and graphite,—the hydrogen, and some carbon and oxygen, being disengaged, probably forming

hydro-carbons, including the oils. In some cases, animal matter may have been the source of the hydro-carbons.

Other native sulphates and petroleums were referred to by the author, who concluded by observing that these products were, most probably, being continually produced by slow chemical change of fossiliferous rocks.

IGNEOUS ROCKS.

MR. SOLLY has read to the British Association a paper upon the Microscopical Structure of Igneous Rocks, as compared with that of rocks melted artificially. He showed that in nature there must be some physical cause which cannot be brought to bear in experiment. He thought that water under high pressure might be this modifying agent in the formation of the crystals of the igneous rocks.

PROF. WARRINGTON SMYTH, F.R.S., has read to the Royal Institution a paper "On Coal, with special reference to its origin and physical character." By the help of large coloured diagrams, and a series of specimens from the Silkstone district, he explained the various conditions in which coal is found, and dilated on the immense advantage which geological research (beginning with William Smith, named the father of British geology) has conferred on coal-proprietors, as indicating to them the circumstances which are favourable or unfavourable to the expectation of coal being found in certain places. As a recent instance Mr. Smyth referred to the success of the Duke of Newcastle, who, from geological deductions, has dug to the depth of 505 yards in a place in Derbyshire seven miles from any coalfield. Considering the immense consumption of coal at the present time, it is encouraging to learn from the researches of geologists in this country and on the Continent that the more the crust of the earth is studied the greater abundance of fossil fuel is likely to be found. In concluding his arguments in proof of the vegetable origin of coal Mr. Smyth gave an interesting account of the appearance of a rich mass of tangled vegetation displayed at the first opening of a coal-mine which he had the opportunity of witnessing, and stated that after strict investigation some botanists had been enabled to classify the mineral, as sigillaria, stigmaria, and lepidodendron coal, from the vegetable structure of which it was mainly composed.

NEW METALS.

PROF. C. F. CHANDLER, in examining native platinum from Rogue River, Oregon, became convinced of the probable existence of a hitherto unobserved Metal.

The quantity of platinum examined amounted to only a few

grammes. It was digested with hydrochloric acid to remove impurities, and the solution thus obtained was subjected to the ordinary routine of qualitative analysis.

A brown precipitate was produced by hydro-sulphuric acid, which dissolved readily in hydrochloric acid on the addition of a crystal of chlorate of potassa. In this solution metallic zinc produced a precipitate which resembled metallic tin obtained under similar circumstances. This precipitate dissolved readily in hydrochloric acid on the application of heat; but the solution thus obtained had no effect on a solution of protochloride of mercury (HgCl), and on cooling deposited a small quantity of minute crystals. To guard against error, these experiments were repeated two or three times on small portions of the original solution, always with the same result.

The chloride of this metal differs therefore from the protochloride of tin, in not reducing protochloride of mercury to calomel, and in being but slightly soluble in the cold.

On mentioning his observations to a friend, Prof. Chandler was referred to Dr. F. A. Genth's announcement of a new metal, made in 1852, of which he was not previously aware.

The metal observed by Dr. Genth occurred among grains of platinum from California. It was malleable; it fused readily on charcoal before the blowpipe, becoming covered with a coating of black oxide; it dissolved in borax to a colourless bead, which became opalescent on cooling; it was dissolved by hot hydrochloric acid and by nitric acid; and its solution gave a brown precipitate with hydrosulphuric acid. It seems quite probable, therefore, that the metal observed in the Rogue River platinum is identical with that observed by Dr. Genth.—*Silliman's American Journal.*

THE GOLDFIELDS OF NOVA SCOTIA.

SUBJOINED is an extract of a mercantile letter from Halifax describing the state of the Goldfields of Nova Scotia:—"I have to report very favourable accounts from the goldfields generally. A lead has been discovered on the Carr lot, on the lands of Townsend, and I have no doubt that rich leads run all through these lands. The prospects for new discoveries and of the localities already discovered continue good. The miners are beginning to send gold to market. The new discoveries which are exciting most attention are those at Elmsdale, on the line of the canal and railroad, and at Nine-mile River, in Hants county. The latter is spoken of as promising great things, and the people in that neighbourhood are quite confident that this locality will prove very remunerative. The Lawrence-town washings look very favourable for the interests of such as are prepared to go into the work in the right way. Tangier, after a long and tedious winter, is looking up. Prospecting, since the weather has improved, has been going on with a good deal of spirit. At present there are three crushers at Tangier; a ton of quartz is stated to have been put through one of them which yielded 3 oz. 3 dwts. of gold, in addition

to 100 dols. worth of specimens taken out of the same lot, making the total yield of gold and specimens 157 dols. for a single ton of quartz."

QUARTZ CRUSHING AND AMALGAMATING GOLD.

THE Esmeralda California *Star* gives the following description of operating Gold Quartz at the Pioneer Mills in Esmeralda :—This mill is run by steam power, using a rotary battery and running eight stamps ; its capacity with double screens on is to crush four and a half tons per day ; without screens, it can crush from five to six. The rock while being crushed is fed with hot water, which causes the amalgamation to work more readily. The pumice passes off through a spout into what are called "Howland's amalgamating pans ;" thence into an arastra, and from thence into a precipitating or amalgamating vat, and is then conducted into what are called "Varney pans," which act as mullers, and grind the pumice down to a perfect pulp, when the final amalgamation is completed : this pulp is now greatly reduced by water, and is carried off by a spout and flows over blankets ; these latter catch and retain the sulphurets and the finer particles of metal which the amalgamators fail to gather ; the blankets are then washed by hand, and the sediment is reduced by what is termed the "Hatch process," which is extensively used at Virginia and Gold Hill. This mill is now crushing rock from the "Wide West" ledge, the owners having a contract to crush 1000 tons.

OCCURRENCE OF FLINT IMPLEMENTS IN THE DRIFT.

MR. BALFOUR STEWART, in a communication to the *Philosophical Magazine*, No. 155, writes :—

Without pretending to be a geologist, I may yet be permitted to point out a general property of matter which may perhaps tend to modify the conclusions which some have derived from the occurrence of flint implements in the drift. Taking it for granted that such implements have been found in this deposit, and that they are the work of human hands, I do not yet feel prepared to allow the great antiquity of our race as a logical conclusion.

May it not be laid down as an axiom in physical science, that no substance whatever possesses a quality in such perfection as to exclude absolutely the opposite and antithetical quality?

In proof of this statement, it may be asserted that the most mobile liquids with which we are acquainted are yet viscous in some degree, and have therefore so far the properties of a solid ; while, on the other hand, some of apparently the most solid bodies exhibit to some extent the properties of a liquid.

A very notable instance of this latter class is found in glacier ice, which, as Principal Forbes has shown, behaves like a somewhat viscous body, gradually moving down its bed, although it may be nearly two centuries before a particle finds its way from the top to the bottom of this river of ice.

May not the drift and superficial deposits which cover the surface of our globe be of this character—somewhat resembling mud, only very much more consistent, but yet not absolutely free from all traces of fluidity?

If this be allowed, it follows that bodies of some size placed in this deposit will in the course of ages find their way from the top to the bottom, if they possess a higher specific gravity than the drift in which they are placed. I

think I am right in asserting that flint implements are of this nature; and it therefore becomes a question whether these may not have a slow downward secular motion in this deposit.

The consequence of such would be that, if merely judged by their position in the drift, we should ascribe to these implements a much greater age than they are really entitled to. This peculiar motion would, however, not take place in the case of human remains coeval with the flints, these remains being of small specific gravity; and we may thus perhaps explain the very remarkable fact, that while flint implements in abundance have been found in the drift, no human remains have as yet been discovered. I need hardly remark that the downward secular motion of the flints which is here supposed must be an exceedingly slow one, perhaps not more than a small fraction of an inch in a year. It would, of course, be very desirable to obtain experimental evidence of such a property of the drift; but this would be an exceedingly difficult and tedious task. In absence of such experiments, corroborative evidence may perhaps be derived from the fact of the disappearance of Roman villas which are afterwards exhumed. Coupling this testimony with that derived from the general character of the matter which surrounds us, it cannot be denied that such a property of the drift is at least possible; in which case we should, I think, be deterred from framing any theory regarding the great age of our race based upon the position of these implements, especially when such views are contradicted by strong evidence from another quarter.

There have been read to the Geological Society the following communications upon this very interesting subject:—

1. "On some Flint Arrow-heads (?) from near Baggy Point, North Devon." By Mr. N. Whitley.

Immediately beneath the surface-soil above the "raised beaches" of North Devon and Cornwall, the author has observed broken flints; and even at the Scilly Isles such flints are found. At Croyde Bay, about half-way between Middleborough and Baggy Point, at the mouth of a small transverse valley, Mr. Whitley found them in considerable number, collecting about 200 specimens, of which about 10 per cent. of the splintered flints at this place have more or less of an arrow-head form, but they pass by insensible gradations from what appear to be perfect arrow-heads of human manufacture to such rough splinters as are evidently the result of natural causes. Hence the author suggested that great caution should be used in judging what flints have been naturally, and what have been artificially shaped.

2. "On some further Discoveries of Flint Implements in the Gravel near Bedford." By Mr. James Wyatt.

Since Mr. Prestwich described the occurrence of flint implements, near Bedford (*Geol. Soc. Journ.* No. 67, p. 366) Mr. Wyatt, Mr. Nall, the Rev. Mr. Hillier, and Mr. Berrill have added seven or eight to the list, from the gravel-pits at Cardington, Harrowden, Biddenham, and Kempston. Mr. J. G. Jeffreys, F.G.S., having examined Mr. Wyatt's further collections of Shells from the gravel-pits at Biddenham and Harrowden, has determined seventeen other species besides those noticed by Mr. Prestwich, and among these is *Hydrobia marginata* (from the Biddenham pit), which has not been found alive in this country. At Kempston, Mr. Wyatt has examined the sand beneath the gravel (which is destitute of shells), and at three feet in the sand (nineteen feet from the surface) he found *Helix*, *Succinea*, *Bithynia*,

Pupa, *Planorbis*, &c., with a flint implement. The upper gravel contained several flint flakes.

NEW FOSSIL.

THE first announcement of this important geological discovery appeared in the *Times* of November 12, 1862, as follows:—In August, 1861, Von Meyer of Frankfort, one of the most distinguished palæontologists of the age, announced the fact that a fossil feather had been found in the Solenhofen slate of Bavaria. This mineral occurs in the upper oolite, and is familiar to every one under the name of lithographic stone. The feather, even to the finest fibre, had been exquisitely preserved, and in structure, could not after the most searching examination be distinguished from the feathers of existing birds. Previously, no certain indications of the occurrence of birds had been detected in strata anterior to the oldest tertiaries. Shortly after the publication of Von Meyer's discovery, it was ascertained that a collector at Pappenheim, in Bavaria, had in his possession a slab of the Solenhofen slate, which presented the remains of a strange creature, differing remarkably from all known birds, and yet provided with feathers. Fortunately for science, a distinguished anatomist of Munich, Professor Oppel, had an opportunity of closely inspecting the Pappenheim slab, and forthwith communicated the results of his examination to Von Meyer, as well as to his colleague at Munich, Andreas Wagner, Professor of Zoology, and keeper of the Natural History Museum of that city. Wagner immediately published a description of this extraordinary fossil in the *Proceedings of the Academy of Sciences* at Munich, although he had never seen the fossil itself and relied entirely on Oppel's account of it. He concluded that the creature was a feathered reptile, and not a bird; and he accordingly named it Griphosaurus, from the two Greek words signifying *enigma* and *lizard*. In April of the past year Von Meyer published a detailed memoir on this fossil (*Palæontographica*, vol. 10), founded likewise on the communication received from Oppel, and not on personal observation. The characters of bird and reptile are so equally balanced in the fossil in question that, with the caution worthy of a true philosopher, he abstained from referring it to either class and proposed for it the appropriate name of *Archæopteryx lithographica*. Translations both of Wagner's and Von Meyer's papers appeared in the *Annals of Natural History* of the past year, and speedily attracted the notice of English palæontologists. An officer of the British Museum was despatched to Pappenheim and succeeded in securing this unique fossil for our National Institution. It was made a *sine quâ non* to purchase the collection of which this was a part, and the sum paid for the whole amounted to not less than 750*l*. What remains of this creature is admirably preserved; but, unfortunately, the head, neck, breastbone, and vertebral column of the body are absent. The fore and hind extremities, the pelvis, and several of the ribs, and the long slender tail—which is perfect

to the tip, are distinctly visible. The foot is formed precisely like that of a bird; the fore limbs are feathered at their extremities; but the mode of insertion of the feathers differs from that of birds. The tail, a bony structure, resembles that of a lizard, and consists of about 20 slender, elongated vertebræ, to each side of which severally a feather is attached. The absence of the head and other important parts of the skeleton is much to be regretted, as without these it is impossible to pronounce with certainty on the affinities of the creature, and for the present we must rest contented with the deduction of Von Meyer; and all that we can say is that it was a feathered animal intermediate between birds and reptiles, wholly different from any creature previously known. It is probable that the followers of Darwin will not be slow to avail themselves of this new discovery, and adduce it in support of the transitional hypothesis respecting the origin of animals.

In a subsequent letter the same Correspondent writes:—The fossil, which, with the exception of a single feather, is the only memorial of its existence, may now be seen in the British Museum. Professor Owen has minutely described it in his elaborate paper read before an unusually large meeting of the Royal Society, and pronounced authoritatively that it was a bird, and not a reptile. It continues, nevertheless, an enigma; for a bird with a bony tail about twice the length of its body would be scarcely, if at all, less remarkable than a reptile with the feathers and feet of a bird. The learned Professor furthermore stated his conviction that this *rarissima avis* must have been a bird of powerful flight; whereupon the Duke of Argyll expressed his doubts as to the sufficiency of the *volant apparatus* for such a function, which elicited the opinion of an eminent ornithologist present to the effect "that that bird never flew." Hence we perceive that even wise men may differ on points which the uninitiated might consider too plain to admit of doubt.

As the sum given for the collection of fossils containing this unique specimen—namely, 750*l.*—might seem excessive, a few words in justification may be desirable. The collection belonged to Dr. Haeberlein, and was offered by him to the Museum of Natural History at Munich for 708*l.*, but declined because it contained only three or four specimens not in duplicate in the rich palæontological collection of that institution, to which Dr. Haeberlein had previously sold a series of Solenhofen fossils for about 900*l.* The sum of 750*l.* paid, or rather agreed to be paid, by our National Museum is not considered unreasonable at Munich. The authority for the preceding statements is the illustrious Von Martius, secretary of the Academy of Sciences at Munich; and it need hardly be added that the authority of this name is ample guarantee for their accuracy. The publication of these high prices in the *Times* will surely operate as a powerful stimulus to further search in the Solenhofen quarries, and may lead to the speedy discovery of the head as well as other missing parts of the "feathered enigma;" if, indeed, the cast of the interior of the

skull, hitherto unrecognised, be not, as conjectured by an able observer, Mr. John Evans, actually visible in relief upon the slab now existing in the British Museum.

FOSSIL HUMAN REMAINS.

We quote the following from the *Athenæum*:—The lively interest excited by the question of Fossil Human Remains, and the contemporaneity of man with animal species now extinct, appears to animate geologists to active research; so that we may expect before long to hear of some positive conclusions in regard to a question so important. The famous Engis skull, as is well known, was discovered by Schmerling in a cave in the province of Liége. M. Malaise, a Belgian palæontologist, exploring in the same province, has recently discovered certain fragments in a cave at Engihoul, which are valuable as evidence. The cave contains a bed of porous and pebbly silt, varying in thickness from two to three feet, under which lies a layer of stalagmite less than two inches thick, and it was while examining the soil beneath the stalagmite that the fragments in question were found. They consist of portions of two lower jawbones and three pieces of skull. In each jawbone the last three molars remain, all but two of which are much worn, and one is decayed. The pieces of skull are identified as fragments of the occipital and parietal bones; one of the latter is remarkably thick (8 millimètres). Pains were taken at the time of the discovery to observe that in their colour, degree of decomposition, and position, the human bones were in no way to be distinguished from the other animal remains which were confusedly accumulated under the stalagmite. These facts will, no doubt, be treated of by Sir Charles Lyell in his forthcoming work on the Antiquity of Man, for it appears it was by his instigation that M. Malaise made the exploration in question. There are numerous scattered facts which will augment the weight of evidence, among which are the fossil bones showing traces of wounds inflicted by some cutting instrument, described by M. Lartet, and the discovery of a skull which exhibits the Negro characteristics in an ancient hypogeum in Egypt.

ANTIQUITY OF MAN.

The evidence of the Antiquity of Man afforded by the Somme valley is the subject of an original article by Mr. John Lubbock, F.R.S., in the *Natural History Review*. Our readers may recollect that, in 1846, M. Boucher de Perthes astonished the scientific world by stating that he had found human implements in beds unmistakably belonging to the age of the drift, of which he published illustrations in 1847. He was then regarded as a mere enthusiast. Since then, however, year by year, the most sceptical have come round to his opinion, including some of the most eminent geologists of the day, such as Sir C. Lyell and Mr. Prestwich.

Mr. Lubbock, in a long memoir, gives an historical sketch of the progress of belief in these ancient Flint Implements, and proposes, as questions to be solved—1. Are the so-called Flint Implements of human workmanship or the result of physical ageneies? 2. Are the flint implement of the same age as the bones of the extinct animals with which they occur? 3. Are we entitled to impute a high antiquity to the beds in which these remains occur? And, 4. What are the conditions under which they were deposited? Three of these questions are answered in the affirmative by those geologists who have given much attention to the subject. But Mr. Lubbock, by collecting and classifying a large quantity of evidence in a somewhat legal manner, has conferred a great benefit on those who desire to obtain a summary view of the present state of the controversy. A section of the strata in which these implements are found, and a coloured engraving of one of them, form illustrations of the paper. Mr. Lubbock says, with regard to the men supposed to have been contemporary with the implements found in the valley of the Somme, "No geologist can return from visiting it without an overpowering sense of the change that has taken place, and the enormous time which must have elapsed, since the first appearance of man in Western Europe."

WOKEY-HOLE HYENA-DEN.

Mr. W. B. Dawkins has described to the British Association the peculiar features of this Den—its accidental discovery, it being filled up to the roof with *débris*, stones, and organic remains—and showed the evidence of human occupation. In three areas in the cave he found ashes of bone, and especially of the *Rhinoceros tichorrinus*, associated with flint and chert implements of the same type as those of Amiens and Abbeville, and to those of the south-west of England. They were, however, of ruder workmanship, and possibly are of an earlier date. They were found underlying lines of peroxide of manganese, and of comminuted bone, and overlying in one of the three areas remains of the hyena, which mark the old floors of the cave. From this he inferred that "man, in one of the earlier, if not the earliest, stages of his being, dwelt in this cave, as some of the most degraded of our race do at present; that he manufactured his implements and his weapons out of flint brought from the chalk downs of Wilts, the least fragile chert of the greensand of the Black-down hills, and arrow-heads out of the more easily-fashioned bone. Fire-using, indeed, and acquainted with the use of the bow, he was far worse armed with his puny weapons of flint and bone than his contemporaries with their sharp claws and strong teeth. The very fact that he held his ground against them shows that cunning and craft more than compensated for the deficiency of his armament. Secondly, that as he was preceded in his occupation, so was he succeeded by the hyena. He then gave a brief summary of the organic remains found, comprising upwards of 1000 bones, 1015 teeth, and 156 jaws belong-

ing to the lion, wolf, fox, bear of two species, badger, *Hyæna spelæa*, ox, deer of six species, Irish elk, horse, and rhinoceros of two species. One of the latter, *Rhinoceros hemitæchus*, stamps the date of the cave as belonging to the preglacial; while the rest of the organic remains belong to the Fauna typical of the postglacial period.

REMAINS OF THE EUROPEAN FRESH-WATER TORTOISE

WERE discovered in Norfolk by Mr. Alfred Newton, in the early part of the past year, while examining a collection of ancient remains in the possession of Mr. Birch, of Wretham Hall, near Thetford. Mr. Newton states "that they consist of a few bones of the limbs and a good part of the outer skeleton of two individuals of the European fresh-water tortoise, *Emys lutaria* of Mérrem (*Testudo europæa* of Bojanus, *Cistudo europæa* of Duméril and Bibron), a species whose existence at any time in the British islands had never before been suspected. They were found, as testified by a label attached to them in Mr. Birch's handwriting, so long ago as June, 1836, in a peat-bog, by the side of a spring-pit, at East Wretham, about seven feet below the surface, and beneath some fifteen hundred laminations of a species of *Hypnum*, which, I understand from Mr. Birch, was pronounced by Sir W. Hooker to be *H. filicinum*." Mr. Newton's opinion on these remains was confirmed by Professors Owen and Bell, to whom he submitted them. He remarks that in these days the geographical range of this little tortoise is somewhat remarkable. It is not found in Holland, Belgium, North France, or North-West Germany, but occurs in Baden, Wurtemberg, Bavaria, Austria, Hungary, and Poland. It is not recognised as an inhabitant of Denmark or Sweden; but its remains have been found in both countries under circumstances similar to those of the Norfolk ones just recorded. Mr. Newton's paper on the subject, illustrated with two plates, has appeared in the *Philosophical Magazine*.

NEW DIPROTODON.

THERE has been read to the Geological Society a paper "On the Premolar Teeth of *Diprotodon*, and on a New Species of that Genus from Queensland in Australia," by Professor Huxley, Sec. G.S. Among a collection of fossil bones from the Darling Down district, in the possession of Dr. Cotton, F.G.S., the author has observed a portion of the right ramus of the lower jaw of *Diprotodon*, and parts of the right and left upper jaws, with the anterior grinders in place, of distinct individuals. Hence he was enabled to offer some observations on the dentition of the genus, and more particularly upon the characters of the premolars. For the form which he finds distinct from *Diprotodon australis* he proposes the name of *D. minor*.

FOOT-PRINTS.

A PAPER has been read to the Geological Society, by Mr. S. H. Beckles, "On some Natural Casts of Foot-prints from the Wealden of the Isle of Wight, and of Swanage." Some of these natural casts are nearly 3½ feet long, indicating not merely the imprints of the toes, but also of the sloping metatarsals. The animal must have been of great size and weight, leaving deep imprints. Little trifid imprints of only 3 inches in length, with a stride of about 13 inches, occurred to the author also in the Isle of Wight. He has found, also, trifids of the usual size in the Wealden of Swanage Bay. Mr. Beckles argued that other Dinosaurians besides the *Iguanodon* have left these track-marks; and he stated that from the first he has been accustomed to associate them with the various phalangeal bones so abundant in the Wealden.

NEW LABYRINTHODONTS.

THE following communications, by Professor Huxley, have been read to the Geological Society :—

1. "Note respecting the discovery of a new and large Labyrinthodont (*Loxomma Allmani*, Huxley) in the Gilmerton Iron-stone of the Edinburgh Coal-field." Looking over the vertebrate fossils from Burdie House and Gilmerton in the University Museum, Edinburgh, Professor Huxley came upon some reptilian specimens —a fragment of the hinder part of the upper wall of a cranium and some sternal plates of a Labyrinthodont, which, from the obliquity of its orbits, he names *Loxomma*. The skull would be about 14 inches long if perfect, and the animal about 6 or 7 feet.

2. "Note on a new Labyrinthodont (*Pholidogaster pisciformis*, Huxley) from the Edinburgh Coal-field." The specimen on which this new form has been determined was placed in the British Museum by Sir P. Egerton and Lord Enniskillen, who recognised it as reptilian. Mr. Davis, of the British Museum, drew Mr. Huxley's attention to it as being probably Archegosaurian. It is not well preserved, but on careful study proves to be an amphibian allied to *Archegosaurus*, differing, however, from it in the form of the head, the extent to which the ossification of the vertebral column has proceeded, and in the character of the dermal armour. This animal was about 44 inches long.

AMERICAN FOSSILS.

A COLLECTION of Fossil Remains found in the Portland (America) stone quarries has been made for the Connecticut Historical Society. Professor Hitchcock pronounces these fossils relics of remote antiquity. Among the specimens are footprints of enormous birds and four-footed beasts, impressions of fern-leaves, and fragments of a behemoth.

THE FORAMINIFERA.

Dr. Carpenter's Introduction to the study of these remarkable beings has been issued by the Ray Society. He has incorporated in his work the fruits of the long-continued and valuable labours of Messrs. W. K. Parker and J. Rupert Jones, in the same field, which greatly tend to simplify the classification usually adoped. They have endeavoured to act up to the character given by Schiller of the true philosopher—"That he loves Truth better than his system, and will gladly give up her old and defective form for a new and fairer one." "In the examination of these foraminifera the physiologist finds," says Dr. Carpenter, "a case in which those vital operations which he is accustomed to see carried on by an elaborate apparatus are performed without any special instruments whatever—a little bit of homogeneous jelly changing itself into a greater variety of forms than the fabled Proteus; laying hold of its food without members, swallowing it without a mouth, digesting it without a stomach, appropriating its food without absorbing vessels or a circulatory system, moving from place to place without muscles, feeling (if it has any power to do so) without nerves; and not only this, but in many instances forming shelly coverings of a symmetry and complexity not surpassed by any of the testaceous animals. The size of some of these organisms is so small that thousands may be contained in a pill-box." The whole group of rhizopods, indeed, possesses features of especial interest to the physiologist, the zoologist, and the geologist. The volume contains twenty-two large plates and numerous woodcuts. The Ray Society was established in 1844, mainly for the publication of such valuable works on natural history as a bookseller would not publish without charge to the author. It well deserves public support.—*Illustrated London News.*

DISCOVERY OF A CORAL BED.

An interesting and valuable discovery, says the *Malta Times*, has been made of a Coral Bed in the Straits of Freghi. It first became known accidentally to a Sicilian dealer in coral, of the name of Michele Criscuolo, who was presented with some fine pieces for sale by a fisherman from Gozo, who was quite ignorant of the value and great importance of the discovery. Criscuolo offered him two scudi (3s. 4d.) a day to fish for him, to which the man very readily agreed. The success was beyond all expectation. In a few days, upwards of 200*l.* worth of the light pink coral, now so much esteemed, was brought up, and Criscuolo appeared in a fair way of making a rapid fortune. So grand a discovery could not, however, be long kept secret, and in a few days as many as forty boats are said to have collected on the spot and tried their fortune with varied success. The bed lies at a depth of about eighty fathoms, and is situated at about a quarter of a mile off the Gozo shore. It is reported that this coral bed was known in the time of the Grand Master Pinto, but that the coral being of a pink colour, it was not considered of any value, the deep red coral being at that time preferred.

VESUVIUS.

THERE has been read to the British Association a paper "On the Last Eruption of Vesuvius," by Dr. Daubeny. The author confines himself to those phenomena which appeared to present some novelty, and to have a bearing upon the general theory of volcanic action. Vesuvius appears during the last few years to have entered upon a new phase of action. Its eruptions are more frequent but less violent than they were formerly; they proceed from a lower level than they did at an earlier period; and they give vent to certain new volatile or gaseous principles, such as the vapour of naphtha and light carburetted hydrogen, or marsh-gas, never before detected. The last eruption has likewise caused an elevation of the coast to the height of 3 feet 7 inches above the level of the sea, which has not been observed on any preceding occasion. In speculating upon the causes which have produced these changes in the nature of the operations of Vesuvius, the author first considers the theory which recognises a second class of volcanoes distinct from those ordinarily known as such, and designated by the name of mud volcanoes. As these are characterized by the emission of carburetted hydrogen and naphtha, as well as of semi-fluid mud, it might be suggested by those who regard them as partakers of the nature of volcanoes, that Vesuvius was now passing into the condition of a mud volcano, from its emitting the same products. But the author finds reason for denying that the so-called mud volcanoes, of which Macalube in Sicily, and Taman in the Sea of Azof, are types, have anything in common with genuine volcanoes, such as Vesuvius, and he therefore contends that the above products are generated simply owing to the action of volcanic heat upon contiguous beds of Apennine limestone containing bituminous matters imbedded. Hence would arise the enormous evolution of carbonic acid observed, and the carburetted hydrogen as well as naphtha vapour which are found to accompany it, and which may be regarded as the secondary and incidental products of volcanic action, whilst the muriatic and sulphureous acids are the primary and effectual ones. The author concluded by recommending to the explorers of volcanic phenomena the accurate examination of the gases evolved, as the best clue to the explanation of the true nature and cause of volcanic action. The latest remarks of Deville and others on volcanic emanations present nothing irreconcileable with the chemical theory of volcanoes, which the author has so long espoused; but all he asks of geologists is, diligently to record the facts, chemical as well as physical, which volcanoes present, instead of contenting themselves with simply referring the eruptions to certain great cosmical changes which they imagine to be taking place.

Astronomical and Meteorological Phenomena.

REPORT OF THE ASTRONOMER ROYAL FOR 1861—62.

At the Annual Visitation was presented the Astronomer Royal's Report, whence are selected the following details :—

The great and principal work of the Observatory, viz., making astronomical observations, has been continued during the past year. Stars to the fifth magnitude (including 192 clock stars), circumpolar stars, stars culminating with the moon, stars occulted by the moon, stars whose proper motion is to be investigated, stars aiding to establish the laws of refraction, stars near Sirius, and some stars remaining from the comparison with Mars, are observed. In this class are also to be included the observations of γ Draconis with the Reflex-Zenith Tube, which are made at every practicable opportunity. The moveable bodies observed are, the Sun, Mercury, and Venus, on every week-day ; the small planets when they pass the meridian before 14 h. ; the large superior planets when they pass before 15 h., or when at the times of their morning-transit the Moon is near ; the Moon at every opportunity.

The Double-Image micrometer was used for three measures of Saturn when his ring was invisible. Ten careful drawings have been made of Jupiter, four of Saturn, and six of Comet 11, 1861. On four days the positions of some of Saturn's satellites have been measured. No observation of Saturn could be made very near to the time of the winter disappearance of his ring.

In the Astronomer Royal's last Report he adverted to the law of the resultant of the combination of Diurnal Inequalities in Declination and Horizontal Force, as deduced from the assemblage of all the observations from 1848 to 1857. On breaking up this large mass into smaller groups, changes of a most singular nature exhibit themselves. These are equally singular as regards their variation in magnitude, as well as in law. The Astronomer Royal states that he is wholly unable to conjecture what cosmical change is indicated by them.

The Astronomer Royal has constructed the prism apparatus for observing the spectra of the fixed stars. Peculiar interest attaches to this most beautiful and powerful means of obtaining some information respecting the composition of those suns which illumine the worlds of far distant regions.—*Abridged from the Athenæum.*

MEASURING HEIGHTS BY THE BAROMETER.

A paper has been read to the British Association, "On the Determination of Heights by means of the Barometer," byMr. J. Ball. The object of this communication is to direct attention to the serious

errors which are involved in the ordinary process of reducing barometric observations taken for hypsometrical purposes. The paper, which is too lengthy for quotation here, will be found in the *Athenæum* Report of the Meeting of the Association.

HELIOTYPOGRAPHY.

MR. WARREN DE LA RUE, F.R.S., has communicated to the *Monthly Notices of the Royal Astronomical Society* a specimen of this art (representing sun-spots, taken at Cranford, Sept. 24, 1861), printed at the ordinary typographical press from an electro copper block obtained from the original negative by means of light and electro-metallurgy, absolutely untouched by the graver. The print of the sun-spots was produced from a collodion negative, taken by means of a Newtonian reflector of 18 inches aperture and 10 feet focal length, on the scale of 3 feet for the sun's diameter. The printing-block was produced by M. Paul Pretsch, according to the method which he has invented.

THE MOON.

MR. LASSELL, F.R.S., writes to the President of the Royal Society, from Malta, May 13, 1862 :—One object on which I scarcely intended to bestow any attention, has fascinated me greatly—I allude to the Moon, in which I see minute details with a hardness and sharpness and reality I have never seen before. My opportunities of scrutiny have, however, been fewer than might have been supposed from my having frequently been engaged in showing this very popular object to many visitors. Yet notwithstanding that I have thus been able to see more into the moon than ever before—so much so that I believe if a carpet the size of Lincoln's-inn-fields were laid down upon its surface, I should be able to tell whether it was round or square—I see nothing more than a repetition of the same volcanic texture, the same cold, crude, silent, and desolate character which smaller telescopes usually exhibit.

CHANGES AMONG THE STARS.

MR. HIND writes from Mr. Bishop's Observatory, Regent's-park, Feb. 3, 1862, to the *Times* :—

Towards the close of the past year it was announced by Professor d'Arrest, of Copenhagen, that a nebula in the constellation Taurus, which was discovered at this observatory on the 11th of October, 1852, had totally vanished from its place in the heavens. That one of these objects, which the giant telescopes of the present day have taught us to regard as assemblages of stars in myriads at immense distances from the earth, should suddenly fade away, so as to be quite imperceptible in powerful instruments, must, I think, have been deemed a very improbable occurrence, even by many who are well acquainted with the care and experience of the observer by whom the statement was made. Within the last few days, however, M. Leverrier has obtained so strong a confirmation of its accuracy, that there is no longer room

for supposing it to have originated in one of those errors of observation which every practical astronomer knows will creep into his work in spite of all his precautions.

The nebula in question was situate in right ascension 4h. 13m. 54s., and north declination 19° 11′ 37″, for the beginning of 1862. It was therefore about a degree and a-half from the star Epsilon in Taurus, in the group commonly known as "the Hyades." Its diameter was about one minute of arc, with a condensation of light in the centre, or its appearance was that of a distant globular cluster, when viewed in telescopes of insufficient power to resolve it into stars. From 1852 to 1856 a star of the tenth magnitude almost touched the edge of the nebula at its north-following edge; it was first remarked on the night the nebula was detected, having escaped notice on many occasions when its position had been under examination with the same telescope and powers. Hence I was induced to hint at its probable variability in a note upon the nebula published in No. 839 of the *Astronomische Nachrichten.* The suspicion is fully confirmed; the star has diminished to the twelfth magnitude, either simultaneously with, or soon after, the apparent extinction of the nebula.

The history of this object and the results of his observations on the night of January 26th are appended by M. Leverrier to his Meteorological Bulletin of the 29th. The sky being very clear at intervals, the Paris equatorial, which has an object-glass 12 French inches in diameter, was directed to the place of the nebula, but, notwithstanding stars of an extremely faint class were visible in its immediate neighbourhood, not the slightest trace of it could be perceived either by M. Leverrier or M. Chacornac. The star which Professor d'Arrest and I have repeatedly noted, of the tenth magnitude, and almost touching the nebula, had dwindled down to the twelfth; so that telescopes which would have shown it well between 1852 and 1856 would not at present afford a glimpse of it. From the fact that M. Chacornac saw the nebula in forming a chart of stars in that region in 1854, and did not remark it while reconstructing the same in 1858 with a much more powerful instrument, there is reason to infer that the disappearance took place during 1856 or the following year.

How the variability of a nebula and a star closely adjacent is to be explained it is not easy to say in the actual state of our knowledge of the constitution of the sidereal universe. A dense but invisible body of immense extent interposing between the earth and them might produce effects which would accord with those observed; yet it appears more natural to conclude that there is some intimate connexion between the star and the nebula upon which alternations of visibility and invisibility of the latter may depend. If it be allowable to suppose that a nebula can shine by light reflected from a star, then the waning of the latter might account for apparent extinction of the former; but in this case it is hardly possible to conceive that the nebula can have a stellar constitution.

It is at least curious that several variable stars have been detected in the region of the great nebula in Orion; that in 1860 a star suddenly shone out in the middle of the well-known nebula Messier 80 (about half-way between Antares and Beta in Scorpio) which vanished in a few days; and that, as first remarked by Sir John Herschel, all the temporary stars, without exception, have been situate in or near to the borders of the Milky Way—the star-cluster or ring to which our system of sun and planets belongs. In the latter class are included the memorable star of B.C. 134, which led Hipparchus to form his catalogue of stars, and those which blazed forth in 1572 and 1604, in the times of Tycho Brahe and Kepler.

In concluding, I will venture to express the hope that some of the many amateur astronomers in this country, who have provided themselves with telescopes of first-rate excellence, will keep a strict watch upon the remarkable pair of variables which I have briefly described in this communication. Continuity of observation is often most important, and can only be secured —and that not always in the uncertainty of weather—by a strong force of observers in different localities.

Since writing the above, I have received a letter from Professor Secchi, the able and energetic director of the Observatory of the Collegio Romano at Rome, by which it appears that in one of the proverbially clear skies of that

city, and with the large telescope at his command, he was unable on the 27th of January, to discern the least vestige of the nebula.

The "Variable Nebula" of Mr. Hind, we are informed, was seen by M. Otto Struve, on March 22nd last, in the great instrument at the Observatory of Pulkova, in Russia. The splendour of this nebula is a little inferior to that of the great comet of 1861, which is always visible. On December 29th last the position of the nebula was determined by means of its proximity to a star of the eleventh magnitude.—*Cosmos.*

THE NEBULÆ.

The Earl of Rosse has communicated to the Royal Society "Further Observations upon the Nebulæ, with practical details relating to the construction of large Telescopes."

In this paper the processes which were found best to answer in casting specula of six-feet aperture have been described at some length; and the precautions which were taken to prevent accidents during the progressive stages of manufacture.

This is followed by a selection from the observations made during a period of six years, accompanied by drawings of the more remarkable objects. The principal results seem to be a large addition to the list of nebulæ with curved or spiral branches, and many new double and multiple nebulæ. A variety of objects have been also pointed out upon which the labour of a careful scrutiny will probably be amply repaid, with a similar instrument, even in this climate. A still larger number have been marked off, which to save time may be passed by, unless some new views on Cosmogony should suggest sufficient motives for reobserving them. A record has been made, which, to some extent, will be available hereafter for comparison with the heavens, and a few cases of suspected change have been noticed, where the evidence, however, is by no means conclusive.

NEW PLANETS.

One of the tenth magnitude was discovered at Marseilles by M. Tempel, on Aug. 29. M. Bruhns stated on the 7th inst. that its position did not belong to any of the known planets, M. Tempel having written to him to verify his discovery. M. R. Luther, at Bilk, has also added another to his discoveries, having observed a new planet on Sept. 1. It has also been seen by M. Tietjen.

M. Robert Luther has informed the French Academy of Sciences that the planet which he discovered on Sept. 1, and for which he proposed the name of Diana, is identical with Daphne, the asteroid discovered by M. Goldschmidt in 1856, and which was lost sight of for six years. The 74th asteroid discovered by M. Tempel is to be named by M. Littrow, Director of the Observatory at Vienna.

THE "COMPANION" OF SIRIUS.

The discovery of this star at Washington, U.S., has created much excitement in the astronomical world. The possibility of its existence was first divined by the great astronomer of Königsberg, Bessel; Pond, the British Astronomer Royal, having previously pointed out remarkable inequalities in the motion of Sirius. Mr. Bond has published further details, amongst which we note that Mr. Safford and Mr. Peters, of Washington, agree in computing the time of the revolution of Sirius to be fifty years. The splendour of the "Companion" is rated at ten-thousandth that of Sirius by M. Chacornac; and M. Leverrier considers the mass of the companion to be one-third or one-fourth that of Sirius. We learn that the companion has been observed at Cambridge, in England.

SATURN AND HIS SATELLITES.

The great telescope of M. Foucault has been the means of obtaining two very interesting drawings. One represents the passage of the satellite Titan over the disc of the planet Saturn; beyond the shadow, M. Chacornac was able to perceive the satellite himself when it was projected upon the brilliant bands in the centre of the planet; at the edges the satellite became invisible. It is the inverse phenomenon of that which takes place when the satellites of Jupiter are seen on that planet; this indicates a difference in the constitution of the atmosphere of the two stars. The second drawing represents the annular nebula of Lyra.

INTRA-MERCURIAL PLANET.

In the Monthly Notices of the Royal Astronomical Society Mr. Carrington has printed a letter from Dr. Von Littrow, of which we give a portion. The latter says that in the *Vienna Times* of April 27, 1820, he finds the statement, probably communicated by his father, that "M. Steinheibel, who for the last four years has daily observed the sun and recorded his spots and faculæ with care in a diary, on Feb. 12, 1820, at 10h. 45m. in the morning, observed a spot which was distinguished from all the rest by its well-defined circular form, by its equally circular atmosphere, by its orange-red colour, and especially by its unusual motion, completing the diameter of the sun in nearly five hours. As he made the observation during a country excursion it was impossible to have recourse to instruments or to communicate the phenomenon early enough to others; yet he is ready to answer every question put to him about this occurrence. It is very possible that a planet might be discovered in this way having its orbit within that of Mercury." This note is very interesting as confirmatory of M. Lescarbault's discovery of Vulcan in 1859, which, however, has been seen again.

We quote the above from "The Scientific News" of the *Illustrated London News*—a department remarkable for the novelty, conciseness, and exactness of its information.

ROSA'S COMET.

TOWARDS the close of July, 1862, a brilliant Comet was plainly visible to the naked eye during the latter days of that month, and was a very conspicuous object throughout the month of August, when it appeared with a considerable tail. Like the comet of 1861, it was favourably situated for observation in the northern heavens, and for some time its course was almost identical with that of the former body, although it did not attain to anything like the lustre of its predecessor. It was first detected at the Cambridge (United States) University, on July 18, and afterwards at Rome by Professor Rosa. It does not bear any resemblance to any former comet in the course which it takes round the sun. During its short stay in northern latitudes it passed through all the changes which are perceived when telescopically examining comets of considerable size and brightness. The fantail and envelopes of light surrounding the nucleus which were visible in the great comets of 1858 and 1861 were seen, though in less degree, in the present one; whilst the changeable jets of light, generally lying in the contrary direction to the tail and proceeding from the nucleus, were very conspicuous features in the comet of the past year. When first seen in Rome it was described as a round, nebulous mass of light with a bright nucleus, whilst a faint tail could be detected by those who possessed a keen sight. At the beginning of August the tail was slender, faint, and of about three degrees in length, and, with the accompanying bright head, appeared like a slender stalk attached to a bulbous root. After this time it became longer, brighter, and broader, although even on the 24th of August it still preserved its resemblance to a stem and bulb.

Between Aug. 25 and Aug. 31 the comet underwent a great change, the tail, instead of appearing as a narrow stem attached to a bulb, spreading out considerably, and now fairly surrounding and being a continuation of the head. It was seen to great advantage on the night of Aug. 31, when it seemed like a miniature of Donati's Comet of 1858. The jet of light, or fan-shaped sector, was very brilliant, and turned in the opposite direction to the tail, as usual. The nucleus was also very bright, and might be compared to a star of the second magnitude. The left side of the tail (which was the part of the heavens towards which the comet was moving) was very sharply defined; the opposite margin was, however, very indistinct. The tail could be traced for a length of from eight to ten degrees with the naked eye.

When the comet was at its shortest distance from the sun (on Aug. 23), its distance from that body was some 93,000,000 miles. When at its shortest distance from the earth, which occurred on Aug. 30, it was removed from us about 33,000,000 miles. The diameter of the head of the comet was reckoned at some 100,000 miles. Its course was retrograde, and its orbit inclined 66 deg. to the ecliptic. Representations of the head of the comet on Aug. 3,

12, and 24, and of the whole comet on Aug. 31, are given in the *Illustrated London News.*

The Comet thus described by M. Hermann Romberg, as seen at Barclay's Observatory, at Leyton, August 21:—

The appearance of the comet is highly interesting. The luminous emanation from the nucleus, nearly in the direction of the sun, is particularly remarkable, and much resembles that exhibited by Halley's comet in 1835. On the 30th of July, when it was first observed here, it appeared as a round nebulosity, with a strong condensation in the middle, and I suspected a fan-like emission of light from the nucleus towards the sun, which was more certainly seen on August 1, when the tail also became visible. On the 3d, 5th, and 7th the nucleus was sharply defined, and as bright as a star of the sixth magnitude; the luminous jet was very distinct, with an amplitude of nearly 50 degrees. Unfavourable weather prevented more than glimpses of the comet until the 14th, since which date its gradual development has rendered it a beautiful telescopic object. The nucleus on the 14th was much brighter, nearly equal to a star of the fourth magnitude, surrounded by extensive nebulosity. The jet was very well defined, and seemed to wave to and fro like a flame. Its position in the telescope was to the left, and made, with the direction of the tail, an angle of about 160 degrees. Its breadth had become less, but the length was increased. On the 18th it was curved at its extremity towards the right, and on the following night the entire jet was on that side, exactly opposite to the tail. It thus appears to have been subjected to an oscillatory motion. Its whole aspect was very much that of a rocket turned aside from the direction of discharge by a strong wind. The diameter of the coma was about eight minutes, or upwards of 100,000 miles; its light was rather brighter on the left of the nucleus. The tail was bifid, the principal branch being much brighter and perfectly straight on the right-hand side; the shorter branch on the left comparatively faint.

METEORS IN AUGUST.

M. Coulvier-Gravier has communicated to the French Academy of Sciences the result of his observations during the maximum of Aug. 9, 10, and 11. Although, on the night of Aug. 11, he could not observe, the heavens being constantly overcast, he found, on tracing the curve of the days preceding and following, that the maximum of the 11th really took place, and that it was sufficiently sensible. The horary number at midnight arose from 14 on Aug. 1 to 52.3 on Aug. 11. On Aug. 13 it was 35.

ZODIACAL LIGHT AND SHOOTING STARS.

Prof. Challis, in a paper read to the British Association, states the phenomena of the Zodiacal Light, as gathered from observations made both in northern and in southern latitudes, to be as follows: As seen in north latitudes, it appears in the west after the departure of twilight as a very faint light, stretching along the ecliptic, about 10° broad at its base in the horizon, and coming to an apex at an altitude of 40° to 50°. It is most perceptible in the west in the months of February and March, at which time its apex is near the Pleiades. Similar appearances are presented in the morning before sunrise in the east, in the months of August and September; the light seen in the autumn lies in the *same* direction from the sun as that seen in the spring. In the southern hemisphere, the appearances are strictly analogous; but the times and positions of maximum visibility are the evenings in autumn

in the west and the mornings in spring in the east. The portion best seen in the southern hemisphere lies in the *opposite* direction from the sun to that which is best seen in the northern hemisphere. The portion seen and the degree of visibility depend on the inclination to the horizon of the part of the ellipse along which the light stretches. The greater the inclination, the better it is seen. At the December solstice, opposite portions have been seen in the northern hemisphere, one in the morning and the other in the evening; and in the southern hemisphere opposite portions have been similarly seen at the June solstice. At these seasons, the ecliptic is inclined at large and equal angles to the horizon, at equal intervals before sunrise and after sunset.

THE ZODIACAL LIGHT,

To which M. Fay has recently called the attention of the French officers now in Mexico, consists of a cone of whitish light, having the sun for its base, and generally perceptible at sunrise and sunset during the equinoxes. In our latitudes it is of rare occurrence, but the nearer we get to the equator the more remarkable is the splendour of the phenomenon. Within the tropics it is almost permanent. The most singular theories have been imagined to explain the appearance of this cone in the heavens. Some have considered it a kind of perspective projection on the celestial canopy of one or more rings of cosmical matter, circulating round the sun, much in the same way as Saturn's rings revolve around that planet. These imaginary rings are believed to lie within the orbit of the earth, but very near to it. M. Biot saw in the zodiacal light a permanent manifestation of one or several rings of shooting stars and aerolites. M. de Tessan, having remarked that the point of the luminous cone was often at a distance of from 90 to 100 degrees from the sun, concluded that this point lay far beyond the terrestrial orbit. According to others, the zodiacal light is simply an immense solar atmosphere, strongly depressed, of a lenticular form, and constituting the matter which feeds the sun. This is the theory of Messrs. Mayer, Waterton, and Thomson. Others, again, consider the phenomenon to be purely terrestrial—a view of the case which does not exactly agree with the inclined position of the zodiacal light, although the earth's atmosphere has been proved to extend much higher than the fifteen leagues formerly assigned to it. Lastly, the Rev. G. Jones, of the United States, imagines the zodiacal light to be owing to the existence of a very thin ring of nebulous matter circulating round the earth, and within the orbit of the moon.—*Times.*

MAGNIFICENT METEOR.

MR. E. J. LOWE, of Beeston, near Nottingham, writes to the *Times*, November 27, 1862:—

A most remarkable meteor was seen this evening. I was standing on the platform of the railway station at Grantham, and had a very fine view of it.

The meteor was somewhat kite-shaped, being nearly equal to the moon in breadth, and above twice her diameter in length (this estimate being taken by looking at the meteor and the moon at the same time). The light was an intense blue, but only intensely bright in the front, mostly as a crescent, but occasionally expanding almost to a circle ; the remaining portion milky white, and dim in comparison.

A train of sparks was left in its path, yet it only lasted from one to two seconds; balls of a blue colour, of large size (almost equal to the apparent diameter of Mars) also fell from the head of the meteor perpendicularly downwards, not continuously, but at frequent intervals. These balls threw out other smaller balls which burst into star-like sparks of a yellowish colour, not unlike the shower from a rocket when seen from a distance.

The meteor gradually increased in size, but not uniformly,—an occasional decrease in size and brightness taking place. It vanished at its *maximum* brightness ; not bursting, but as if going behind some opaque body.

I did not see the commencement, owing to a building, but, from the testimony of the Grantham station-master, it must have commenced very near to where I first saw it. If the path were produced backwards it would cross the Pleiades. My view commenced near α Ceti, and after progressing some distance the meteor passed almost over β Ceti, and then immediately above Fomalhaut, vanishing 4 deg. beyond this star, and about 5 deg. above my horizon.

The meteor gave a very strong impression that it was a non-luminous body, the light being produced by the friction of its velocity in the air.

THE WIND.

PROFESSOR AIRY has observed some curious facts respecting the direction of the Wind. It seems that there are only eight points of the compass from which the wind ever blows steadily for any length of time—namely, the S.S.W., the W.S.W., a point between the W. and N.W., another between the N. and E., another between E. and S.S.W., the N., the W., and the E. The wind never blows directly from the south.

MONSOONS.

THE effect of the Monsoons in causing an influx of a large mass of fresh water into the sea has been observed by Sir William Denison, the Governor of Madras, who, while steaming between Mangalore and Cananore, on the west coast of India, found that for some time after the south-west monsoon, the sea was offensive with dead fish killed by the fresh water poured in during the season of the monsoon. The fact was reported in a letter to Sir R. I. Murchison, which was read at a late meeting of the Geological Society.

TYPHOON AT CANTON.

A TYPHOON, of terrific violence, passed over Canton and Whampoa on July 27, 1862. "Of Whampoa," says a letter from Hongkong, August 10, "it may actually be said that there is not a house left standing, but the whole length and breadth of the country have suffered to a degree unparalleled in its own history. The loss of life at Canton is estimated at more than 40,000 persons; and the Mandarins have paid already upwards of 15,000 dollars, at a dollar a body, for the recovery of corpses from the river. The boat population of Canton perished by the thousand, and there was hardly any safety in the frail tenements on shore. The river rose twelve feet above the level of the highest spring-tides. The mud docks at Whampoa were without exception flooded, and the vessels in them floated off the blocks, and were driven by the force of the wind hard and fast into the mud, one or two being hopelessly lost.

A Correspondent of the *Athenæum* Journal, a merchant in Canton, thus describes the terrific visitation—

"The wind got furious, when the matting flew off the houses like paper-shavings, and the tiles seemed to flutter about like sparks; the rain was swept along, and the river itself like dust, and then, in rapid succession, dashed by junks, flower-boats, cargo-boats, every kind of boat, but all perfect wrecks, most of them bottom up, some on their side, dashing against each other, and either sinking or being heaped up in one confused pile on shore. Then came floating by a long line of wreck nearly a mile long—spars, timbers, tops of boats, disabled boats, many with people still on board, but very many more without one still living of their late occupants. The river rose rapidly until it overflowed into the houses, and in some of the streets was three to four feet deep; the rain all the time descending in torrents, and the wind raging as if it were mad. This continued for about an hour and a half, when it suddenly fell quite calm, and the sun appeared. This did not last long; the wind in an instant sprang up from another quarter, and blew with greater fury than ever. The wind being now against the tide, the river appeared like a sea, the waves dashing over the wrecks and sending the spray twenty to thirty feet high. This continued until evening, when it moderated to an ordinary gale. The following morning the scene of destruction which presented itself is beyond description: houses were blown down in every direction, verandahs torn off others; trees, some with roots bigger by far than our drawing-room, and more than 300 years old, were rooted up like carrots. But sadder still was the frightful loss of life; it is estimated to be over 20,000, and I fear there is no exaggeration in this. In one house nearly opposite to us, 120 people were killed by its falling. Hundreds were drowned by the tide rising in their own houses, and preventing their escape. Sixty war-junks had anchored about half-a-mile from us a few days before; these were new and fully manned, and on their way to the North. Of these junks only ten are left, and these perfect wrecks, and upwards of 500 of their crew have perished. The mandarins, immediately after the typhoon, issued proclamations offering one dollar for any body brought to them, in order that it might be claimed by relatives,—or if not, buried. There were several stations appointed where the bodies were to be brought: at *one* only, within a mile of this, in less than twenty-four hours, 1200 were brought; and within three days, upwards of 6000. At Whampoa the destruction of property and loss of life have been equally great. Baurboo Town and New Town are entirely destroyed, and nearly every soul in them must have perished. Ships in dock are overturned: many are stranded. One steamer is now quietly lying in the midst of a paddy-field, and a chop-boat is driven more than a mile from the river. This may seem incredible. The Consul read to me the official report, and it stated these facts, which I also heard from others. The river rose ten feet higher than it has ever been

known to reach in the highest spring-tides, and it was impossible to distinguish where the river's channel was. With the fury of the wind, this wide expanse of water became like a sea, driving all before it. It was thus that the boat was left far from the river when the water subsided."

METEOROLOGICAL DEPARTMENT.

A Report has been issued from the Meteorological Department of the Board of Trade, giving a full account of its methods and proceedings, and tracing the progress and operation of the department from its organization by Mr. Cardwell seven years since. By the present arrangements, pre-intimations of the greater atmospheric changes are measured by days rather than by hours, and the knowledge of the state and signs of the weather, at a certain number of selected stations far apart, enables Admiral Fitzroy, who presides over the department, to place these intimations at the service of all. The direction and force of every air-current or wind reported from these stations, their respective pressure, temperature, moisture or dryness, and their changes since the last observation, are all weighed and measured mentally before each day's report is issued. To ascertain that no very bad weather is imminent is often important; and the general opinion at the ports is, that the storm warnings are of great value. A broad general average or prevalence is kept in view in these forecasts, referring to a day or more in advance, and to a district rather than only to one time or place; and it cannot but be well that when disturbance is spreading in the atmosphere, mariners should get a cautionary telegram—"Be on your guard; notice your glasses and the local signs of the weather." Be the cause what it may, it is happily the fact, that comparatively few wrecks have occurred on our coasts since the communication of these storm warnings was begun.

HOWSON'S BAROMETER.

This new instrument, as made by Messrs. Negretti and Zambra, has been exhibited at the Royal Institution. This Barometer is stated to be of extraordinary sensitiveness, the vertical range, or extent of its rise and fall, being nearly five times as great as that of the ordinary standard barometer. Its action depends upon the principle, that if a light stem, or hollow closed tube, be attached to the bottom of the cistern, and passed centrally up the column of mercury, so that the top comes nearly into the vacuous space, the cistern with its contained mercury will be held in free suspension, and will require no external support beyond that which it obtains from the natural pressure of the atmosphere. The consequence of this arrangement is, that the cistern becomes also sensitive to variations of pressure, and obeys the atmospheric fluctuations to even a greater extent than the column itself. The cistern and the column thus move simultaneously, the motion of one reacting upon and influencing that of the other in such a manner as to increase the range to any required extent within certain limits. The instrument, on account

of the extreme facility with which its indications may be observed, is especially adapted to coast purposes, while it promises also to be of great value in the hands of agriculturists, as giving conspicuously the earliest possible notice of approaching rain or fair weather.

ANCIENT CLIMATE OF EGYPT AND PALESTINE.

M. Unger, the eminent botanist, at a meeting of the Imperial Academy of Sciences at Vienna, has announced that he has recognised by the microscope, organic remains in a brick brought from the city of Eyleïthyia, in Egypt. Among these remains fragments of eight different species of plants have been rigorously determined, differing in nothing from the corresponding parts of the species of the present day found in Egypt and Arabia, either in the wild or cultivated state. Hence M. Unger considers that a lapse of thirty or forty centuries (the probable age of the brick) has caused no material change in the climate or vegetation of Egypt. The learned Austrian botanist hopes by more extensive researches to obtain still further light on the nature of the flora of ancient Egypt. In the *Edinburgh Philosophical Journal*, Principal J. D. Forbes expresses his conviction, founded on a series of observations of the growth and maturity of the date-palm, compared with the evidences in Scripture of its distribution and culture in ancient Palestine, that the mean temperature of the country, when reduced to the level of the sea, can then have differed very little from 70 deg. Fahr., its present rate according to the best authorities.

HAILSTONES.

Remarkable Hailstones are described and figured by Mr. Thomas Sutton in the *Proceedings of the Royal Society*. The district over which the hail fell on the 7th of May last, at Headingly, near Leeds, was very narrow. The fall was preceded by a violent storm. The hailstones did not fall in a continuous shower, but in irregular clusters. Sometimes a field would be thickly strewn with them, whilst an adjoining one escaped with hardly any; one part of a greenhouse would be much broken, and the remainder, similarly exposed, escape uninjured. So great was the force, that in some cases circular holes were cut in the glass, without the sheet being otherwise injured. The end of a pendulous branch of beech, 12 in. long and $\frac{3}{8}$ in. in circumference, was cut from the tree, and several larger branches from apple and lilac trees. The hailstones were of different forms and sizes, and Mr. Sutton sketched no less than forty varieties, some of a very fantastic form. The heaviest weighed by Mr. Sutton was 2 oz., but some weighed by other persons were said to be upwards of 5 oz. One cake-shaped hailstone had a radiated mass resembling a mushroom rising out of it. Another stone was composed of five large masses of ice, quite clear, and in size like nutmegs.

METEOROLOGY OF 1862.

Results deduced from the Meteorological Register kept at the Royal Observatory, Greenwich, during the year 1862.

1862. Months.	Mean Reading of Barometer.	Temperature of Air. Highest by Day.	Lowest by Night.	Range in Month.	Mean of all Highest.	Mean of all Lowest.	Mean Daily Range.	Mean for Month.	Departure from average of 21 yrs.	Mean Temp. of the Dew Point.	Mean Tension of Vapour.	Weight of Vapour in a cubic ft. of Air.	Mean additional Weight required for saturation.	Mean Degree of Humidity. Saturation=100.	Mean Weight of a cubic foot of Air.	Relative proportion of Wind. N	E.	S.	W.	Mean Amount of Cloud. 0 to 10.	Rain. No. of Days it fell	Amount collected.
	In.	°	°	°	°	°	°	°	°	°	In.	Grs	Gr.		Grs.							In.
Jan.......	29·705	55·0	20·4	34·6	43·9	34·3	9·6	39·0	+0·9	34·6	·200	2·3	0·5	85	552	4	4	11	12	7·8	17	1·9
Feb.......	29·905	56·3	24·4	31·9	46·5	36·7	9·8	41·1	+2·5	36·6	·217	2·5	0·5	84	553	5	8	7	8	8·5	6	0·5
March..	29·498	63·6	22·5	41·1	50·0	38·4	11·6	43·1	+1·3	39·5	·242	2·8	0·4	86	544	6	8	9	8	8·9	22	3·7
April....	29·847	75·0	26·7	48·3	57·5	41·7	15·8	48·4	+2·1	43·0	·277	3·1	0·8	81	545	4	5	10	11	7·3	13	2·8
May......	29·726	81·5	37·8	43·7	66·4	47·9	18·5	55·4	+2·9	50·3	·365	4·0	0·9	84	534	4	6	9	12	8·3	16	2·8
June.....	29·718	73·5	43·4	30·1	67·1	49·3	17·8	56·3	−1·8	49·3	·352	4·0	1·1	77	533	7	1	7	15	7·8	16	1·8
July......	29·762	79·0	44·6	34·4	70·8	50·8	20·0	59·1	−2·7	52·4	·394	4·5	1·2	78	531	3	0	8	20	7·2	16	1·5
Aug......	29·785	79·9	44·7	35·2	71·0	51·4	19·6	59·5	−1·9	53·5	·410	4·6	1·1	81	530	7	6	8	10	6·9	14	3·0
Sept......	29·859	73·8	39·2	34·6	67·6	50·1	17·5	57·7	+0·8	52·5	·396	4·4	0·9	83	534	6	9	8	7	7·7	18	1·6
Oct.......	29·726	71·7	28·5	43·2	60·5	45·6	14·9	51·8	+1·8	48·6	·343	3·8	0·5	89	538	4	5	8	14	7·1	17	4·0
Nov.......	29·793	57·0	24·8	32·2	45·8	34·3	11·5	39·8	−2·9	37·4	·224	2·5	0·3	92	553	11	5	8	6	7·3	8	1·0
Dec.......	29·865	57·1	33·4	23·7	48·0	38·6	9·4	43·6	+3·5	40·3	·250	2·8	0·4	88	550	4	2	10	15	7·5	16	1·6
Means...	29·768	68·6	32·5	36·1	57·9	43·3	14·6	49·6	+0·6	44·9	·306	3·4	0·7	85	541	65 Sum	59	103	138	7·7	179 Sum	26·2 Sum

NOTE.—In column 10 the sign + implies above, and the sign — below the average.

EXPLANATION.

The cistern of the barometer is about 159 feet above the level of the sea, and its readings are coincident with those of the Royal Society's flint-glass barometer. The observations are taken daily at 9 A.M., noon, 3 P.M., and 9 P.M.; the means of these readings are corrected for diurnal ranges by the application of Mr. Glaisher's corrections, in the *Philosophical Transactions*, Part I., 1848; and from the readings of the dry and wet bulb thermometers, thus corrected, the several hygrometrical deductions in columns 11 to 16 are calculated by means of Mr. Glaisher's Hygrometrical Tables. *Second Edition.*

The numbers in column 2 show the mean reading of the barometer every month, or the mean length of a column of mercury which balanced the whole weight of atmosphere of air and water; the numbers in col. 12 show the length of a column of mercury balanced by the water alone; and if the numbers in this column be subtracted from those in column 2, the result will be the length of a column of mercury balanced by the air alone, or that reading of the barometer which would have been, had no water been mixed with the air. [*Concluded on next page.*

The mean temperature of the air for the year was 49°·6; and that of the dew-point was 44°·9. The mean degree of humidity was 85, complete saturation being represented by 100. Rain fell on 179 days; the amount collected was 26·2 inches.

The cold weather, which set in on December 25th, 1861, and which was mentioned in the *Year-Book of Facts for* 1862, continued till January 6th, 1862; the mean daily defect being ½°. From the 7th to the 15th was 7½° above, then for the next six days was 8° below. A period of warm weather followed, extending to the 6th of February; within which some of the days were as much as 13° to 15° in excess, and the average daily excess for the 15 days was 8°. From the 7th of February to the 16th was cold; the daily defect of temperature was 3½°. The next six days were in excess to the amount of 8° daily; then from the 24th of February to the 5th of March there was a daily deficiency of 5½°, followed by a period of nine days whose daily average was 7° in excess; this period was succeeded by another ending the 21st of March, of deficient temperature to the amount of 2¼° daily; and from the 21st of March till the 7th of April the mean daily excess was 5°. On the 8th of April a cold period set in which continued till the 16th, the mean daily defect being 5°. This was succeeded by a period of very warm weather, which continued, with the exception of the 3rd, 9th, 13th, 14th, 15th, 21st, and 22nd of May, and the 5th of June, until the 8th of June; the mean daily excess of the 53 days ending the 8th of June was 3° nearly. On several days during this period the weather was above its average to large amounts, as on the 25th of April it was 12°·6 in excess: the 4th, 5th, and 6th of May were 8°·5, 11°·1, and 13°·6 in excess. On the 9th of June a cold period set in, continued with but few and trifling exceptions till the 12th of September; the average daily deficiency of temperature during these 96 days was 2¼°. Within this long period there were 12 days only on which the temperature of the air reached or exceeded its average value; and the excess above the average, on the very few days so distinguished, was generally less than 3°; and on one day only, viz., the 8th of September, it was as large as 5°. Within this period of 96 days rain fell on 40 days to the amount of 7 inches. The wind blew from the North or a compound of the North on 26 days, from the S.W. on 35 days, the West on 28 days, South 3 days, and from the S.E. and E. 4 days. From the 13th of September till the 17th of October, the weather was warm, the mean daily excess being 3½°. On the 18th a variable, but mostly cold, period set in, and continued to the 30th; the average deficiency of temperature was 1½° daily. This was succeeded by a week of warm weather. A cold period set in on November 6th, and continued till December 2nd, a deficiency of temperature being experienced of 4½° daily; and from December 3rd to the end of the year there was an average excess to the same amount, viz., 4½° daily.

The mean reading of the barometer was above its average value in February, April, September, October, November, and December; and in defect in the remaining six months of the year.

The mean reading of the barometer for the year at the level of the sea was 29·946 inches.

The mean temperature of the air was above its average value of 91 years, in January by 0°·9; February by 2°·5; March by 1°·3; April by 2°·1; May by 2°·6; September by 2°·9; October by 2°·4; and December by 4°·6. And below in June by 2°·9; July by 2°·7; August by 1°·9; and November by 2°·6.

The mean high day temperature was above the average value of the preceding 21 years, in January, February, April, May, September, October, and December; and below in the remaining months of the year.

The mean low night temperature was above the average value of the preceding 21 years, in January, February, March, April, May, September, October, November; and in defect the remaining months of the year.

The temperature of the year 1862 was 0°·6 in excess of the average of the preceding 21 years.

The highest temperature of the year was 81°·5 in May, and the lowest 20°·4 in January; giving a range of temperature of 61°·1.

The mean weight of a cubic foot of air was 552 grains in January, 533 in June, and 550 in December; and the average for the year was 541 grains.

Obituary.

LIST OF PERSONS EMINENT IN SCIENCE OR ART. 1862.

Dr. Hawtrey, Provost of Eton; a good linguist.

Henry Thomas Buckle, author of the *Introduction to the History of Civilization in England*, a work which deals too fairly with the prejuices and errors of the present age to find general favour.

Eugene O'Curry, one of our most laborious archæologists and Gaelic scholars.—*Athenæum.*

Dr. Charles Vogel, Director of the principal School of Leipsig, and author of several geographical works translated into English and other languages.

J. Lewis Ricardo, well known as a writer on Free-Trade and the Navigation Laws, and in connexion with the extension of the Electric Telegraph system.

Matthew Cotes Wyatt, sculptor of the colossal equestrial statue of the Duke of Wellington at Hyde Park Corner.

C. B. Robinson, civil engineer.

J. E. Fromenthal Halevy, musical composer.

James Elmes, architect, and author of the *Life of Sir Christopher Wren.*

John Thomas, sculptor of many architectonic statues at the New Houses of Parliament; and numerous other works.

Lieutenant-General John Tulloch, engineer.

The Rev. Frederick W. Hope, naturalist.

Edward Gibbon Wakefield, political economist.

Thomas Wakley, originator and editor of the *Lancet.*

H. Harram de Sennamont, mineralogist.

John Edward Jones, sculptor.

James John Berkeley, civil engineer.

Francesco Carlini, Italian astronomer.

M. Jomard, the eminent French geographer.

Jean Baptiste Biot, the celebrated French astronomer, and man of letters. In 1800 he was appointed to the chair of Natural Philosophy in the College of France, and elected a member of the Academy of Sciences, when only 28 years of age. In 1806 he was a member of the Bureau des Longitudes; and in conjunction with Arago continued a series of researches on Gases, which had been commenced by Borda. With Arago he assisted in extending the French arc of meridian, and for this purpose visited Spain, and subsequently embarked for England. In 1840, he received the Rumford Medal for his researches on the Polarization of Light. His labours in physical science were very extensive. He was long the editor of the mathematical section of the *Journal des Savans.* He published an analysis of the *Mecanique Celeste* of Laplace; a work on *Analytical Geometry applied to Curves and Surfaces of the Second Order,* of which an 8th edition was published in 1834; and an *Elementary Treatise on Physical Astronomy,* 3rd edition, 1850; besides other scientific works of the highest merit.

Lucas Barrett, the "Island Geologist" of Jamaica; he lost his life by diving in the harbour of Port Royal.

Dr. Joseph Hamel, distinguished by the invention of an electrical machine. In 1820 Dr. Hamel made a well-known ascent to Mont Blanc, when he lost several of his guides. He was elected, in 1828, "Membre de l'Académie Impériale des Sciences de St. Petersbourg." It was through his exertions that the first Exhibition of industry took place at Moscow. He was afterwards employed in several other Exhibitions in Russia, and, taking the liveliest interest in the progress of industry, he visited all the great Exhibitions which have since taken place in France, England, and even the one at New York in 1854. Dr. Hamel published a history of the steam engine, a work written with the precision and care distinguishing all his scientific researches. He also published a history of the electric telegraph, which is very complete in a scientific point of view.

Admiral Sir James Clark Ross, the celebrated Arctic voyager. The deceased was the third son of Mr. George Ross, of Balsorroch, in the county of Galloway, and nephew of Sir John Ross, C.B., and was born in 1800. The following sketch of his life is from Dod's *Peerage and Baronetage:*—He entered the navy in 1812; became Rear-Admiral of the

White in 1858; served in all the naval expeditions for the discovery of the North-West passage from 1818 to 1833; discovered and planted the British flag on the North Magnetic Pole in 1831; crossed the Atlantic to relieve the frozen whalers in Baffin's-bay in 1836; commanded the expedition to the Antarctic regions from 1839 to 1843; attained the highest latitude ever yet reached (78 deg. 10 min.), and approached within 160 miles of the South Magnetic Pole. He received the honorary degree of D.C.L. from Oxford in 1844, was elected a Fellow of the Royal Society in 1827, and of the Linnæan Society in 1823, and was also honorary member of the Society of Northern Antiquaries of Copenhagen, corresponding member of the Geographical Society of Paris, &c. He received the founder's gold medal from the Geographical Society of London in 1841, the gold medal of the Geographical Society in Paris in 1842, and a piece of plate from the subscribers to the land Arctic Expedition in 1833.

JAMES BOWMAN LINDSAY, of Dundee, the originator of a scheme for telegraphing across rivers and seas without wires or cables. The *Dundee Advertiser* says—"He had discovered as early, if not earlier, than Morse or Wheatstone, the principles of the present system of electric telegraphy. Immediately after the public adoption of the system of land telegraphy, Mr. Lindsay directed his attention to the sending of messages across water by means of insulated wires; and succeeded—after several trials on ponds and sheets of water in the neighbourhood—in establishing on a sure basis the principles of electric communication by insulated submerged wires. Nor did he stop here: his searching experiments inspired him with the hope that one day he would be able to transmit messages across rivers and seas without even the aid of wires. Mr. Lindsay so far perfected his invention as to transmit currents without the aid of wires across several small pieces of water—the last occasion on which he publicly experimented with this invention being in Portsmouth, about two years ago, when he was highly successful, and the results afforded great satisfaction to the scientific men who assisted."

PROFESSOR BARLOW, F.R.S. His mathematical acquirements and his energetic character displayed themselves at an early age. In 1806 he was appointed one of the mathematical professors at the Royal Military Academy at Woolwich, which office he held until 1847. He was the author of numerous works, among which are his well-known treatises on the "Theory of Number," the "Strength of Materials," and the "Essay on Magnetism." His discovery of the means of correcting the local attraction on the compasses of ships brought him into great notice. In mechanical subjects he was associated with Mr. Telford in experiments for the Menai Bridge.

SIMON FRASER, the discoverer of the river which bears his name. One of his brothers was a captain and another a lieutenant under General Wolfe, and participated in the capture of Quebec.—*Panama Star.*

MR. HART, of Wallace River, who was over 90 years of age, and had worked all his life at the problem of perpetual motion.

FRANCIS OLIVER FINCH, one of the oldest members of the Society of Painters in Water Colours.

MR. ROSS, C.E., member of the Institution of Civil Engineers, and many years connected with some of the earliest and largest railway works in this country, but more recently with railway enterprise in Canada, where he constructed the great bridge over the St. Lawrence.

JOHN EDWARD ERRINGTON, C.E., whose name was intimately associated with that of the late MR. Joseph Locke, M.P., in the history of railway enterprise. Mr. Errington was born at Hull in the year 1806, and was actively engaged in the development of the railway system, especially upon those lines connecting England and Scotland; and, with Mr. Locke, was engineer to the Glasgow and Greenock Railway and Dock, the Lancaster and Carlisle, the Caledonian, the East Lancashire, the Scottish Central, Scottish Midland, and Aberdeen railways. About the year 1850, Mr. Errington was appointed, jointly with Mr. Locke, consulting engineer for the northern division of the London and North-Western Railway; and in that capacity constructed many of the branches

and extensions of that system. He was also, up to the time of his death, engineer-in-chief to the London and South-Western Railway; and superintended the construction of the lines, just completed, connecting that system with Exeter and the West of England. (*Builder.*) Mr. Errington was a Vice-President of the Institution of Civil Engineers, and proved his attachment to the Institution, and his desire to see it prosper, by bequeathing to it the sum of 1000*l.*, free of legacy duty, and without attaching any condition whatever to the gift.

JOHN WEALE, the eminent publisher of works on Architecture and Civil Engineering. Some remarkable "Statistical Notices of Works on the Fine and the Constructive Arts," circulated by Mr. Weale, show, that while his career had been a struggle, it was also a labour of love, and so had brought its delights. He had expended at his own risk in publications 209,502*l.*, and at the risk of authors, 29,695*l.* On his admirable "Rudimentary Series" alone he had risked about 50,000*l.* This, as we have heard from his lips more than once, proved a very successful venture.—*Builder.*

DR. THOMAS STEWART TRAILL, Professor of Medical Jurisprudence in Edinburgh. He possessed a scientific knowledge connected with his professional duties, and a general knowledge connected with his editorial duties, not often equalled in their extent and profundity. The uniform excellence of the recently published edition of the *Encyclopædia Britannica* may be, in great part, ascribed to Dr. Traill, who, as the editor of that important work, went carefully through every single article, and furnished above four hundred from his own pen.—*Athenæum.*

JAMES WALKER, C.E., one of the oldest members of the profession, having been in active practice as an engineer for upwards of sixty years. He was also one of the earliest members of the Institution of Civil Engineers, having joined it in the year 1823, and, after the death of Mr. Telford, became its President for eleven years. Mr. Walker's name was associated with many of the greatest hydraulic works in England and Scotland, including lighthouses, harbours, bridges, embankments, and drainage. His opinion was much valued by the Elder Brethren of the Trinity House, by the Lords of the Admiralty, and by the Corporation of the City of London, and it must not be forgotten, especially at the present moment, that twenty years ago he laid down lines for embanking each side of the River Thames, which have never been improved. Mr. Walker left at Mr. Burges' disposal the twenty-five remaining copies of Telford's *Life and Works*, as well as the copyright and the copper-plates, which Mr. Burges has in the most handsome and liberal manner presented to the Institution of Civil Engineers.—*Address of Mr. John R. M'Clean, Vice-President.* Mr. Walker bequeathed to the Royal Institution the admirable Bust in marble of Professor Faraday, — Noble, sculptor.

SIR BENJAMIN COLLINS BRODIE, bart., the distinguished Surgeon, and the first surgeon elected to the President's Chair of the Royal Society. From his own College he received all the honours that institution has in its power to bestow on those members who have upheld the honour, dignity, and welfare of the profession, having been elected professor, a member of Council, of the court of examiners, Hunterian orator, and, finally, in 1844, president. Sir Benjamin Brodie had contributed largely to the advancement of medical and chirurgical knowledge, and was a member of most of the learned and scientific societies, both at home and abroad. In modern times it is not possible, perhaps, to name any one who has more powerfully contributed to the improvement of medical science in any of its branches, or who has more assiduously exerted himself to acquire scientific and professional information, and ungrudgingly to disseminate that knowledge, than this illustrious surgeon. Certainly, no member of the profession had reached so high a position, or maintained that distinction for so long a period, as the late President of the Royal Society. [A Portrait of Sir Benjamin Brodie, with a Memoir, appeared in the *Year-Book of Facts*, 1859.]

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